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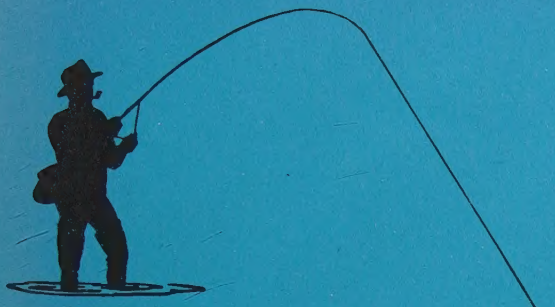

SPORT FISHERY ABSTRACTS

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Vol. 13, No. 2, 1968

Abstracts 9762 - 9961

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BUREAU OF SPORT FISHERIES AND WILDLIFE

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BUREAU OF SPORT FISHERIES AND WILDLIFE

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Use of funds for printing this publication approved by the Director of the Bureau of the Budget January 19, 1966

Prepared in the Division of Fishery Research

Washington, D. C.

SPORT FISHERY ABSTRACTS

An abstracting service for fishery research and management

Vol. 13, No. 2 Abstracts 9762-9961 1968

Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of published articles on limnology, ecology, natural history and other fields of specialization are included when the subject has application to the conservation and management of sport fishery resources.

One volume consisting of four numbers is issued each year. Each number contains separate Author and Subject indexes. The final number of each volume contains cumulative Author and Subject indexes and a list of publications screened.

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Bureau of Sport Fisheries and Wildlife
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Washington, D.C. 20240

9762. Honstead, John F., and David N. Brady (Pac. Northwest Lab., Battelle Mem. Inst., Richland, Wash.). 1967. THE UPTAKE AND RETENTION OF ^{32}P AND ^{65}Zn FROM THE CONSUMPTION OF COLUMBIA RIVER FISH [SALMON AND SCRAP FISH]. Health Phys., 13(5): 455-463. Illus.; Biological Abstracts, 48(16): Abst. No. 78621. 1967.

Hanford reactors discharge effluent cooling water into the Columbia River resulting in the incorporation at low concentrations of ^{65}Zn and ^{32}P in aquatic organisms. These radionuclides in the aquatic food chain may ultimately enter man's diet by way of fish caught and eaten by local fishermen. The determination of exposure level from the ingestion of these radionuclides in fish requires evaluation of their absorption and retention by man. Seven volunteer subjects participated in a study of the uptake and retention of ^{32}P and ^{65}Zn as a result of eating Columbia River fish. Analysis of the fish provided ingestion data while whole-body counting techniques established the resulting body burdens. A beta counter calibrated for ^{32}P body burden measured the retention of this radionuclide. In addition, excreta and blood samples were collected and analyzed to evaluate uptake and transfer parameters. The experiment provided new estimates of the fractional uptake of radiophosphorous (100 percent) and radiozinc (35 percent) from fish, as well as their effective half-lives. As a result of utilizing several subjects in the experiment, a measure of the possible variation of the value of these parameters among members of the population is provided. (Authors)

9763. Erickson, James G. (Fort Lewis Coll., Durango, Colo.). 1967. SOCIAL HIERARCHY, TERRITORIALITY, AND STRESS REACTIONS IN SUNFISH. Physiol. Zool., 40(1): 40-48; Biological Abstracts, 48(16): Abst. No. 78805. 1967.

Twenty-five groups of 4 sunfish (Lepomis gibbosus) were investigated for aggressive actions. A hierarchy was found for each of the groups. Size and sex were both important in determining the makeup of the hierarchy, with larger fish and males tending to be dominant. The fish were not highly territorial, but some territorial behavior was observed in 10 of the 25 groups. Investigation of stress reactions centered around 3 possible morphological adaptations: spleen weight, total body weight and quantity of interrenal tissue. The first 2 showed no correlation with the social rank of the fish. The quantity of interrenal tissue was correlated with the number of aggressive actions initiated by each fish, with a correlation coefficient of -0.466, which is significant. (Auth.)

9764. Kwain, W., and H. R. McCrimmon (Dept. Zool., Univ. Guelph, Guelph, Ont., Canada). 1967. THE BEHAVIOR AND BOTTOM COLOR SELECTION OF THE RAINBOW TROUT, Salmo gairdneri Richardson, EXPOSED TO DIFFERENT LIGHT INTENSITIES. Anim. Behav., 15(1): 75-78; Biological Abstracts, 48(16): Abst. No. 78841. 1967.

Fingerling trout exposed to series of white light intensities over a uni-colored bottom of either black or white were distributed randomly. Yearling trout were similarly distributed randomly over a black background but when held over a white background exhibited a preference for the edge of the tank; when exposed to a choice of black or white bottom coloration, the fingerling trout exhibited no preference under the series of test light intensities. Yearling trout, however, showed a significant preference for the black bottom at low but not higher light intensities. (Authors)

9765. Krokhin, E. M. 1957. ENRICHMENT OF SPAWNING LAKES WITH BIOGENIC ELEMENTS. Izvest. Tikhookeansk. Nauchn. -Issled. Inst. Rybn. Khoz. i Okeanog. 45: 29-35; Referat. Zhur., Biol., 1958, No. 74356. (Translation); Biological Abstracts, 48(16): Abst. No. 79020. 1967.

The carcasses of Oncorhynchus nerka left after spawning enrich the spawning lakes with biogenic elements. Using the "hydrobiologic productivity" method, (Frantsev, Mikrobiologiya, 1(2), 1932) it was established that the waters of two spawning lakes in Kamchatka contained more biogens than lakes in which spawning does not take place. The absolute content of phosphates in the former was 3-1/2 to 5 times higher. --Courtesy NSF (PL 83-480) 1963.

9766. Birman, I.B. 1959. FURTHER INFORMATION ON THE EFFECT OF THE KURO-SHIO ON POPULATION DYNAMICS OF SALMONS. In: Problems of ichthyology. Moscow. 13. 16-18; Referat. Zhur., Biol., 1960, No. 76528. (Translation); Biological Abstracts, 48(16): Abst. No. 79040. 1967.

The long-range population fluctuations of Sakhalin herring and Oncorhynchus keta in the Bol'shaya River on Kamchatka are comparable. When the Kuro-Shio warms the sea, the stock of O. keta increases; when the sea cools, it decreases. Contrarily, the number of O. gorbuscha decreases with warming and increases with cooling. In winter, O. gorbuscha migrates farther south than O. keta and spends the winter in warm waters, nearer to the fronts of the Kuro-Shio and North Pacific Current. In the first winter after its descent from the rivers, O. keta remains close to the coast in waters subject to strong cooling in winter. The Kuro-Shio affects O. keta and O. gorbuscha diametrically. Since their habitats in the sea are distinct, it would seem that the differences in population fluctuations are due to the effect of the Kuro-Shio on the fish during their oceanic phase. -- Courtesy NSF (PL 83-480) 1963.

9767. Buckow, Ed. 1968. THE PEACOCK BASS PROJECT. Field and Stream, 72(12): 54-55, 146-147.

Species of South American fish, the butterfly bass and the peacock bass, are being considered for introduction in Florida lakes. Florida biologists plan to import four species of peacock bass and try them in test ponds. These fish sometimes weigh as much as 17 pounds, have good sport qualities, and are good eating.

9768. Bruemmer, Fred. 1967. EELING IN QUEBEC. Can. Audubon, 29(1): 11-14. Illus.; Biological Abstracts, 48(16): Abst. No. 79042. 1967.

Between the Quebec cities of St. Jean and Iberville a curiously shaped structure zigzags across the Richelieu River. It is an eel weir, the largest, oldest and most productive in Canada. It was constructed 110 years ago. Today the giant trap is operated by Lucien Thuot, grandson of the builder, with his son and grandson. Together they continue a tradition going back many centuries. (Auth.)

9769. Calderoni, Pompoe (Ist. Istol. e Embriol., Fac. Sci., Univ. Perugia, Perugia, Italy). 1965. CONTRIBUTION TO THE STUDY OF GROWTH OF THE PIKE (Esox lucius L.) LIVING IN THE TRASIMENO LAKE. Riv. Idrobiol., 4(1/2): 3-15. Illus. (Engl. summ.); Biological Abstracts, 48(16): Abst. No. 79044. 1967.

Of a sample of 179 pike (Esox lucius L.) caught in the Trasimeno Lake, gonads maturation, sex ratio and growth have been studied. Ovary and testes, with mature oocytes and sperms, respectively, were found in 1-year-old animals. The female-male sex ratio was about 2 to 1; this appears to be due to the fact that males older than 4 years were less prevalent. Growth appears to be similar in males and females up to the 4th year, reaching an average of about 40 cm long in both sexes. Females grow further reaching about 70 cm long at the 8th year. (Auth.)

9770. Day, Dwane E. 1966. POPULATION STRATIFICATION AND HOMING BEHAVIOR IN JUVENILE COHO SALMON (Oncorhynchus kisutch). Fish. Res. Pap., 2(4): 75-79. Map; Biological Abstracts, 48(16): Abst. No. 79050. 1967.

The employment of marked-unmarked ratio methods of population estimation was demonstrated to be inappropriate as a means enabling evaluation of fish production in a brackish-water area where a population of juvenile coho was being reared. Observations revealed the population to be geographically stratified and efforts to induce marked fish to distribute themselves randomly in the population by displacing them some distance from the site of their capture failed. Fish so displaced homed to the area of their initial capture with a high degree of reliability. Some mixing of the population did occur over a 4-week period; however, this may have been a result of the beginning of smoltification. (Auth.)

9771. Demchenko, I. 1959. FINGERLINGS OF Esox lucius IN CARP FATTENING PONDS. Rybovodstvo i Rybolovstvo 4. 14-15; Referat. Zhur., Biol., 1960, No. 30487. (Translation); Biological Abstracts, 48(16): Abst. No. 79051. 1967.

The simultaneous breeding of 2-year-old carp and commercial fingerlings of Esox lucius in drainable fattening ponds permits food resources of ponds to be utilized more fully and gives an additional yield of 40-60 kg/ha of commercial fingerlings of Esox lucius. The number of food competitors of carp is reduced and this can increase the carp yield by 9-10%. --Courtesy NSF (PL 83-480) 1963.

9772. Fotiev, A. V. 1959. EFFECT OF DEOXYGENIZED GROUND WATER ON FISH. Byul. Inst. Biol. Vodokhran, Akad. Nauk SSSR 4. 44-45; Referat. Zhur., Biol., 1960, No. 71453. (Translation); Biological Abstracts, 48(16): Abst. No. 79055. 1967.

Ground water entering the Rybinsk Reservoir creates suffocation conditions in some places which cause the death of fish. --Courtesy NSF (PL 83-480) 1963.

9773. Johnson, Ray C. 1966. THE EFFECT OF ARTIFICIAL CIRCULATION ON PRODUCTION OF A THERMALLY STRATIFIED LAKE. Fish. Res. Pap., 2(4): 5-15. Illus.; Biological Abstracts, 48(16): Abst. No. 79062. 1967.

Summer stratification at Erdman Lake was believed to be limiting coho salmon production. During 2 periods in 1960 only 15% of the lake volume was found to be inhabitable due to high surface temperatures and low oxygen beneath the thermocline. Circulation of the lake was induced through introduction of compressed air into the hypolimnion during the summers of 1961, 1962, and 1963. Mixing of the lake was accomplished in 2 weeks. Comparison of primary productivity rates (carbon uptake) before and after circulation revealed acceleration due to the mixing. While inorganic phosphate values were negligible both before and after, an increase in inorganic nitrate was noted following circulation. During 1963 an extreme accumulation of phytoplankton was observed prior to mixing. Since little evidence of intense plant production was present, it was possible that decimation of the lake zooplankton population by rotenone poisoning had lessened predation and permitted a large buildup of phytoplankton. Coho smolt production for 3 years before the circulation was compared to 3 years with the treatment. While mean size of smolts decreased slightly, survival rate and numbers of fish produced were more than tripled. (Auth.)

9774. Lasater, J. E. 1966. TAG LOSS AND MORTALITIES OF SMALL CHINOOK SALMON. Fish. Res. Pap., 2(4): 90-93; Biological Abstracts, 48(16): Abst. No. 79073. 1967.

Petersen disc, spaghetti, and dart tags as described and applied herein are undesirable for experiments on chinook salmon ranging from 17 to 22 cm fork length. Judging by the combined tag loss and mortality, dorsal Petersen tags and dorsal spaghetti tags with knots gave the best results. Dorsal spaghetti tags with monel clamps were the poorest. Tag loss was mechanical in nature. After shedding a tag, chinook salmon of from 17 to 22 cm fork length are able to heal the resulting wound so that it is not visually discernible. (Auth.)

9775. McFarland, William N., and Sanford A. Moss (Sect. Ecol. and Syst., Cornell Univ., Ithaca, N. Y.). 1967. INTERNAL BEHAVIOR IN FISH SCHOOLS. Science, 156(3772): 260-262. Illus.; Biological Abstracts, 48(16): Abst. No. 79081. 1967.

Structural changes within fish schools correlate with declines in environmental oxygen. The changes may result from the responses of individual fish to the environmental consequences of group metabolism. Individual behaviors are adaptive to the school in that they tend to maintain stability between school members and their environment. (Authors)

9776. Poddubnyi, A.G. 1965. SOME RESULTS OF REMOTE OBSERVATIONS ON THE BEHAVIOR OF MIGRATING FISHES. In: Bionics. Nauka: Moscow. 255-263. From:Ref. Zh., Biol., 1966, No. 5I118. (Translation); Biological Abstracts, 48(16): Abst. No. 79087. 1967.

Conventional migration schemes, constructed from tagging data, indicate only the general direction of motion from the point of release of the fish to the point of their recapture. However, an understanding of migration patterns, of navigational adaptations of fishes and of their effects, can only be achieved through a knowledge of the actual migration route. The experiments were conducted with bream of the Rybinsk Reservoir. The fish were tagged with a fine nylon-type thread and float, the end of the thread being attached to the dorsal fin. The exact location of the float was determined by means of a sextant and direction finder every hour or several times an hour. On being released, local fish started to move in circles after which they selected the required direction and usually headed toward the point of capture. Fish imported from other regions frequently changed direction after release, describing a zigzag course, particularly in the absence of a current. During the spring spawning period, this type of search has led the fish to the inshore zone and then to the spawning area. During the summer feeding period the fish tended to return to the home waters. In transplanted fish, coincidence of the direction of their movements with the direction of the magnetic meridian was observed in 87.5% of the individuals; in local fish the coincidence amounted to 50%. Coincidence of the direction of the fishes' movements with the direction of the magnetic meridian increased sharply as the stability of the medium increased. The observations showed the orientation of fishes to be dependent upon temperature, electrical conductivity of the water and depth, the effect of each of these factors being governed by changes in the others. The role of sight and smell in the navigational complex apparently was small, since their elimination produced no difference in the behavior of surgical and control fish. The speed of migrating fishes varied according to the season, the time of day and the environmental conditions; during the feeding period it varied also in relation to the diurnal feeding rhythm.

9777. Quistorff, Elmer. 1966. FLOATING SALMON SMOLT COLLECTORS AT BAKER RIVER DAMS. Fish. Res. Pap., 2(4): 39-52. Illus.; Biological Abstracts, 48(16): Abst. No. 79090. 1967.

Floating smolt collector devices were developed to fill the need for a method to pass salmon smolts downstream in the absence of spillway discharges at 2 high dams on the Baker River. Horizontal louvers were used to guide and pass the smolts in about 1% of the original water inflow to the collector. An evaluation was conducted to measure the efficiency of these devices in attracting, collecting, and transporting available smolts; and to determine the resulting adult catch and escapement for coho and sockeye salmon. Passage of smolts at the upper collector was 168,000 "1" coho and 143,000 "1" sockeye between March 7 and June 25, 1961. Smolts of these species exhibited similar migration patterns with respect to time of day at both collectors. Marked smolt recaptures at the Upper Baker Dam collector were low—55% for coho and 34% for sockeye. It was believed that survival of the marks was poor, and that these results were not indicative of the true efficiency of this collector in catching all available smolts. Efficiency of the Lower Baker Dam collector approached 100% when calculated on the basis of non-marked releases from the upper collector. Marked recoveries, however, again indicated low efficiency. Resultant record adult returns for both species indicate that the Baker River runs can be maintained and perhaps enhanced by use of the collectors in the absence of spillway discharge. (Auth.)

9778. Webb, R.D., and R.E. Noble. 1966. A DEVICE FOR RANDOMLY SAMPLING JUVENILE FISH POPULATIONS. Fish. Res. Pap., 2(4): 94-103. Illus.; Biological Abstracts, 48(16): Abst. No. 79110. 1967.

A mechanized unit consisting of a specially designed hub, split internally into 6 radial segments with attached spokes, is the essential part of a random sampling machine for fish of less than 160 mm length. This unit rotates so that the spokes receive the sample of fish and water from a jet pump. In a series of 69 separate

tests, it was demonstrated that by changing the circumference of the wheel it was possible to obtain predetermined samples ranging from 6.6% to 45%. Maximum variation in the test samples was plus or minus 1.1% at a 14-inch setting. Minimum variation in the test samples was plus or minus 0.2% at a 10-inch setting. (Authors)

9779. Windell, John Thomas (Dept. Biology, Univ. Colo., Boulder, Colo.). 1966. RATE OF DIGESTION IN THE BLUEGILL SUNFISH. Invest. Indiana Lakes Streams 7. 185-214. Illus.; Biological Abstracts, 48(16): Abst. No. 79671. 1967.

This study is an initial attempt to compare the rate of digestion and absorption of several different natural food organisms by the bluegill sunfish (Lepomis macrochirus). The rate of digestion was measured as the difference between the weight of food intake and food remains in terms of digestible organic matter. Similar results were obtained when total protein digestion was measured by means of micro Kjeldahl nitrogen determinations. Meals of natural food organisms required about 18 hours for complete digestion by the bluegill. Digestion was most rapid during the first 6 hours, with the digestible organic matter in the stomach decreasing by about 50%. Meals of mayfly naiads, crayfish, and darters all reached 100% digestion after 18 hours, whereas chironomids and oligochaetes reached 92.9 and 97.8%, respectively. A meal of 3 dragonfly naiads, because of a drop in temperature, reached only 85% digestion after 18 hours. The rate of digestion of a voluntarily consumed mixed meal of 25 chironomids, 1 dragonfly naiad, and 1 oligochaete showed that only 15% of the food remained in the stomach after 10 hours. No differences were observed in the rate of passage or relative digestibility of the different food organisms. Chitin lingered in the stomach until being broken into small pieces before passing through the pyloric valve. Special studies were conducted on the effect of force-feeding, starvation, body size, and size of the meal on the rate of digestion. Bluegills that were force-fed mealworms showed considerable individual variation in digestion when compared with control fish that voluntarily consumed meals. The variation was great enough so that the outcome of subsequent experiments could not be predicted accurately. Bluegills starved from 7, 14, and 25 days showed a progressive decrease in rate of digestion when compared with control fish. The decreased digestive efficiency appeared to be a result of shrinkage and other morphological changes that occurred in the pyloric caeca. A comparison of the combined average differences in percentage digestion at each of the sacrifice intervals showed that control fish digested 1.25, 1.85, and 2.22 times faster than fish starved for 7, 14, and 25 days, respectively. Comparison of the rate of digestion of single- and multiple-unit meals by fish of the same relative age and weight showed that the stomach empties at about the same rate. As the size of the meal was increased by 2.7 times, the rates of digestion per unit time increased 2.2 times. Among fish of different ages and body weights, the time required for the stomach to empty of single- and multiple-unit meals was not significantly different. A method is presented for establishing the "maximum daily ration" for fish in the laboratory. Comparisons of laboratory and field information will lead to ecological predictions concerning both fish and fish-food populations in relation to growth and production in aquatic ecosystems. (Auth.)

9780. Randall, D. J., and J. C. Smith (Dept. Zoology, Univ. Brit. Columbia, Vancouver, B. C., Canada). 1967. THE REGULATION OF CARDIAC ACTIVITY IN FISH IN A HYPOXIC ENVIRONMENT. Physiol. Zool., 40(2): 104-113. Illus.; Biological Abstracts, 48(16): Abst. No. 79803. 1967.

The response of the heart and breathing movements to environmental hypoxia were studied in the rainbow trout Salmo gairdneri Richardson. Ventilation volume was found to increase during hypoxia. Bradycardia and cardiorespiratory synchrony were shown to develop simultaneously in response to lowered environmental O_2 tensions and both phenomena appear to be mediated via efferent cholinergic fibers of the ramus cardiacus of the vagus. Experimental evidence was obtained which indicates that the receptors involved in bradycardia and cardiorespiratory synchrony are located peripherally either in the buccal cavity or on the surface of the gills themselves. (Authors)

9781. Randall, D. J., and E. Don Stevens (Dept. Zool., Univ. Brit. Columbia, Vancouver, B. C., Canada). 1967. THE ROLE OF ADRENERGIC RECEPTORS IN CARDIOVASCULAR CHANGES ASSOCIATED WITH EXERCISE IN SALMON. Comp. Biochem. Physiol., 21(2): 415-424. Illus.; Biological Abstracts, 48(16): Abst. No. 80662. 1967.

Intravenous injections of epinephrine produced an increase in dorsal aortic blood pressure and heart rate. Low dose levels of epinephrine caused a reflex slowing of the heart, a response abolished by atropine injections into the pericardial cavity. Phenoxybenzamine injections blocked the pressor response to epinephrine. Changes in blood pressure during activity and excitement also disappear after α-adrenergic receptor blockage with phenoxybenzamine. It is concluded that there are α-adrenergic receptors in blood vessels in the gills and in the general body circulation. Epinephrine probably causes a vasodilation in the gills and a vasoconstriction of blood vessels peripherally in the systemic circulation. Blood pressure changes occurring during swimming can be explained by the interaction of epinephrine with α-adrenergic receptors. Dichloroisoproterenal or propranolol, when injected intravenously in fish, had little effect on the response of the heart to epinephrine, but caused a marked fall in dorsal aortic blood pressure and heart rate. (Authors)

9782. Luk'yanenko, V. I., and B. A. Flerov (Inst. Biol. Int. Waters, Acad. Sci. USSR, Borok, Yaroslavl Oblast, USSR). 1966. EXPERIMENTAL ANALYSIS OF THE RELATIONSHIP BETWEEN THE TOXIC RESISTANCE OF THE RAINBOW TROUT AND ITS AGE AND BODY WEIGHT ON A PHENOL INTOXICATION MODEL. Vop. Ikhtiol., 6(2): 375-380. Illus.; Biological Abstracts, 48(16): Abst. No. 80841. 1967.

In a comparative study of the life span of yearling and 2-year-old rainbow trout in 5 to 25 mg/l phenol solutions, the role of the age factor was revealed: as the age of the fish increases their toxicoresistance falls. Two to 10-fold increases in the average weight of the rainbow trout had no substantial effect on its life span in 10 to 15 mg/l phenol solutions. The time of death for the fish showed a reliable decrease when their average weight was increased by 10 to 22 times. (Auth. summ. transl.)

9783. Thompson, R. R. (Div. Food Stand. and Additives, Food and Drug Admin., Washington, D. C.). 1967. DISK ELECTROPHORESIS METHOD FOR THE IDENTIFICATION OF FISH SPECIES. Ass. Offic. Anal. Chem. J., 50(2): 282-285. Illus.; Biological Abstracts, 48(16): Abst. No. 83294. 1967.

A collaborative study was made of a disk acrylamide gel electrophoresis method for identifying fish species through the use of characteristic protein bands. Results were generally satisfactory; 6 of 7 collaborators agreed on all samples. It is recommended that the method be adopted as official, first action. (Auth.)

9784. Gustafson, P. F. 1967. COMMENTS ON RADIONUCLIDES IN AQUATIC ECOSYSTEMS. In: Proceedings of an International Symposium on radioecological concentration processes, 25-29 April, 1966, Stockholm, Swed., Pergamon Press, Symposium Publications Division: London and New York. pp. 853-858; Biological Abstracts, 48(17): Abst. No. 83803. 1967.

Levels of ^{137}Cs ranging from 100 to nearly 5000 pCi/kg wet weight were observed routinely in a variety of freshwater fish available commercially in the U.S. Investigations of the metabolic behavior of ^{137}Cs in fish from Red Lake, Minnesota, showed increases in concentration by factors of 2 and 5 on going through 2 successive trophic levels. Samples of bottom sediments showed accumulations of ^{137}Cs near the mouth of the principal river flowing into Lower Red Lake. Fish specimens from past seasons indicated increasing levels of ^{137}Cs through 1965, suggesting dependence upon the total accumulation of ^{137}Cs in the lake ecosystem rather than upon the rate of accumulation. Urine specimens from native inhabitants of the area who ate fish regularly were 2 to 3 times higher in ^{137}Cs content than those from persons eating a more urban diet. The overall concentration factor relating ^{137}Cs activity in fish to that in lake water was 2,760. By analogy, fish

living in a similar environment for prolonged periods of time with ^{137}Cs concentrations in water being 2 x 10^{-8} Ci/l. (0.2 MPC_{water} (Maximum Permissible Concentration) when eaten in limited quantity by man, would produce at equilibrium, ^{137}Cs body burdens 60 times greater than the MPL (Maximum Permissible Limit) for the general population. The retention of ^{54}Mn and ^{65}Zn was found to be a unique feature of euryhaline fish, with ^{65}Zn apparently being retained in an ocean environment. (Auth.)

9785. Nelson, D. J. (Health Phys. Div., Oak Ridge Natl. Lab., Oak Ridge, Tenn.). 1967. THE PREDICTION OF ^{90}Sr UPTAKE IN FISH USING DATA ON SPECIFIC ACTIVITIES AND BIOLOGICAL HALF LIVES. In: Proceedings of an International Symposium on radioecological concentration processes, 25-29 April, 1966, Stockholm, Swed., Pergamon Press, Symposium Publications Division: London and New York. pp. 843-851.; Biological Abstracts, 48(17): Abst. No. 83821. 1967.

White crappies (Pomoxis annularis) were collected monthly from the Clinch River and flesh and bone samples were analysed for Ca and Sr. Bone samples were analysed for ^{90}Sr. Four additional species of fish were sampled on a limited basis for comparison. The objective of the research was to determine whether the uptake of ^{90}Sr by fish could be predicted on the basis of stable Sr concentrations in river water and fish tissue. A good agreement was observed between the specific activity of ^{90}Sr in water and white crappie bone, indicating that it is possible to predict ^{90}Sr concentrations in fish when the specific activity of the water is known. The specific activity approach with ^{90}Sr is considered superior to the use of ^{90}Sr-Ca ratios. This was illustrated by the fact that among 5 species of Clinch River fish, differences in either the Ca or Sr concentrations would affect the accuracy of predictions based on Ca concentrations. The biological half-life of Sr in white crappie flesh ranged from 12 to 48 minutes, showing that fish flesh will reflect quickly changes in the environmental ^{90}Sr concentrations. (Auth.)

9786. Ophel, I. L., and J. M. Judd (At. Energy Can. Ltd., Environ. Res. Br., Chalk River, Ont., Canada). 1967. EXPERIMENTAL STUDIES OF RADIOSTRONTIUM ACCUMULATION BY FRESHWATER FISH FROM FOOD AND WATER. In: Proceedings of an International Symposium on radioecological concentration processes, 25-29 April, 1966, Stockholm, Swed., Pergamon Press, Symposium Publications Division: London and New York. pp. 859-865.; Biological Abstracts, 48(17): Abst. No. 83824. 1967.

There is a wide variation in radiostrontium retention from food by fish. Some of the factors affecting retention are: food composition; specific activity of food; and feeding habits of the fish. Under some circumstances, food may contribute more radiostrontium than water to the body-burden of fish living in a contaminated environment. Predictions of the relative contributions of food and water to the radiostrontium burden and estimates of the magnitude of the body-burden in fish must take into account the influence of these factors. (From auth. aumm.)

9787. Chandler, Clay M. (Bethel Coll., McKenzie, Tenn.). 1966. ENVIRONMENTAL FACTORS AFFECTING THE LOCAL DISTRIBUTION AND ABUNDANCE OF FOUR SPECIES OF STREAM-DWELLING TRICLADS. Invest. Indiana Lakes Streams 7. 1-56. Illus.; Biological Abstracts, 48(17): Abst. No. 84116. 1967.

The objective of this study was to define some of the factors in the lotic environment of 4 triclad species (Turbellaria), and to relate certain of these features to the local distribution and abundance of these planarians. Using a time sample technique, 17 monthly collections of planarians were made in 2 streams about 5 miles west of Bloomington, Indiana. These observations showed that Cura foremani was abundant at the headwaters of Richland Creek but was replaced downstream by Dugesia tigrina. In Leonard Springs Branch, Phagocata gracilis gracilis occupied only the headwater and upstream areas and was replaced downstream largely by Dugesia dorotocephala. The latter species also occurred upstream but not at the headwaters. Several physical and chemical parameters were investigated. Temperature, water level (discharge), substrate and changes in bottom character, calcium, and dissolved organic matter seemed directly

related to the distribution and abundance of the triclads. Continuous daily records and weekly maximum-minimum readings for one year indicated that the mean annual temperature fluctuation in both streams was less upstream (1.5-5.1° C) than downstream (5.6-8.8° C). Moreover, upstream areas had cooler summer means (15.4-18.7° C) and warmer winter means (6.8-8.2° C) than those downstream (20.7-21.3° C; 3.0-4.9° C). That temperature influences distribution is indicated by the fact that all species except D. tigrina were comparatively more abundant in upstream areas of less temperature variability. The more exact nature of this relationship was revealed from laboratory observations that compared the acclimation capacity, reproductive capability, and general activity of each species over a range of 1-35° C. In general, the rather limited distribution of P. g. gracilis to cooler upstream areas seemed partly related to its apparently cold, stenothermal nature, and the similar distribution of C. foremani to its comparatively higher reproductive capability at lower temperatures. The scarcity of D. tigrina upstream as opposed to downstream seemed partly related to its comparative decrease in general and reproductive activity at lower temperatures. A relationship for D. dorotocephala was not readily apparent. Biweekly observations of other parameters indicated that the relatively high calcium content of both streams (65-91 ppm) contributed to a chemically stable and generally productive environment. Dissolved organic matter was frequently less than 5 mg O_2/L absorbed from $KMnO_4$, which suggested no gross pollution. However, Richland Creek generally had higher values than Leonard Springs Branch, which could have excluded D. dorotocephala from Richland Creek, since this species is reputedly highly sensitive to pollution. There was a general inverse relationship between discharge and triclad abundance. High discharge in the spring suggests that C. foremani was unable to maintain position in the otherwise slowly flowing headwaters of Richland Creek, which could have accounted for its absence from the continually swift current upstream in Leonard Springs Branch. Flat, angular stones not easily moved by the current supported larger numbers of triclads than more rounded rocks that continually shifted. Only the upstream areas of Leonard Springs Branch had an abundance of stones covered with silt and $CaCO_3$, which afforded a unique substrate for the unstalked egg capsules of P. g. gracilis. The abundance of P. g. gracilis and D. dorotocephala in an apparent transition zone alternated reciprocally throughout the year, which suggested interspecific competition and migrational behavior in P. g. gracilis. A field analysis of monthly changes in the size structure of the P. g. gracilis population suggested that breeding occurred mainly in autumn and winter and that hatching was predominantly in late spring and summer. (Auth.)

9788. Lythgoe, J.N. (Med. Res. Counc., Inst. Ophthalmol., London, England). 1966. VISUAL PIGMENTS AND UNDERWATER VISION. In: A Symposium of the British Ecological Society on light as an ecological factor, 30 March - 1 April, 1965, Cambridge, Engl., John Wiley and Sons, Inc., New York. Brit. Ecol. Soc. Symp., 6: 375-391. Illus.; Biological Abstracts, 48(17): Abst. No. 84126. 1967.

The emergent idea is that the visual pigment in a fishes eye compromises between the rival demands of contrast and sensitivity. On this basis the facts are fitted quite well, but the contrast sensitivity hypothesis may turn out to be a fool's paradise. The problem of bioluminescence has been ignored here and yet to a diver in murky water the only visible thing may be bioluminescence even at noon at 30 m (Hemmings and Lythgoe, 1964). The visual effects of blue-green bioluminescence in yellow inshore waters will eventually have to be evaluated, and comparison between the visual pigments of fishes living in inshore waters and in fresh waters of similar color but without bioluminescence would be very interesting. No mention has been made of the invertebrates whose visual pigments seem chemically identical to those of vertebrates. Kampa et al. (1963) have discussed the relationship between the photic environment and sensitivity in several species, and in crustacea considerations of sensitivity might alone explain the known facts. It will be interesting to learn whether crustacea do have different visual pigment requirements from fishes and if so whether the reason lies in the

different requirements of the compound eye. Absence of data about the relevant optical quantities has limited the scope and value of these calculations. But it would be a mistake to think that knowledge of them would automatically put a solution to these ecological problems within reach. Each species of fish has its own peculiar habits of living, and these must have relevance. Only in the last decade has the aqualung allowed a study of fishes to be made where it should be made—in their own environment. Without such knowledge of the natural history of fishes the problems of underwater visual ecology can only be half solved. (Auth.)

9789. Fleminger, Abraham, and Hans T. Klein [Editors]. 1966. CALIFORNIA COOPERATIVE OCEANIC FISHERIES INVESTIGATIONS. ATLAS NO. 4. xiii+ 288 p. Maps. Scripps Institution of Oceanography: La Jolla, Calif.; Biological Abstracts, 48(17): Abst. No. 84161. 1967.

This is the fourth in a series of atlases containing hydrographic and plankton data from the region of the California current. This number of the series contains an article "Geostrophic flow of the California current at the surface and at 200 meters", by J. C. Wylie. There is a reference list with the article, and 288 pages of maps showing the work done and reported in the article.

9790. Underhill, James C., and John B. Moyle. 1968. THE FISHES OF MINNESOTA'S LAKE SUPERIOR REGION. The Conservation Volunteer, Minnesota Conservation Department, 31(177): 29-53.

9791. Hedlich, Rolf (Stollberger Str. 3F, Karl Marx-Staolt, East Ger.). 1966. ON THE PLANT NUTRIENTS WASHED OUT OF THE FOREST SOIL AND THEIR INFLUENCE ON THE QUALITY OF WATER IN RESERVOIRS. Wiss. Z. Karl Marx Univ. Leipzig. Math. Natur. Wiss. Reihe 15(1): 217-227. Illus.; Biological Abstracts, 48(17): Abst. No. 84181. 1967.

The results show, that an increased supply of biologically usable phosphorus compounds leads to an increased plankton production. In order to preserve the oligotrophic status of the Neunzehnhainer reservoirs, it is necessary to keep phosphorus compounds away. This is valid for many lakes and reservoirs. Phosphate washed out of forest soils can be concentrated. Under the influence of heavy precipitation and at the beginning of the melting of snow up to 18 μg P (PO_4)/l were found in the afflux of the Lower Neunzehnhainer Reservoir. This is more than the limit of 10 g/l, at which Sawyer (1952) expects a mass development of the phytoplankton. The investigations also show that the highest amount of phosphorus washed out was found in an old tree population and not in the clear-cut area. (Auth. summ. transl.)

9792. Bailey, R. G. 1966. THE DAM FISHERIES OF TANZANIA. East Afr. Agr. Forest J., 32(1): 1-15. Map; Biological Abstracts, 48(17): Abst. No. 84194. 1967.

Dams constructed for domestic and agricultural purposes in Tanzania have been successfully stocked with fish. The geographical distribution of dams is discussed with some consideration of their physical, chemical and biological characteristics. The use of Tilapia in stocking dams is described together with the present distribution of these and other self-stocked species. A review of the fisheries exploitation of dams in Tanzania is made and a few estimates of the annual crops from dams are presented. (Auth.)

9793. Hemmings, C. C. (Mar. Lab., Aberdeen, Scotland). 1966. FACTORS INFLUENCING THE VISIBILITY OF OBJECTS UNDERWATER. In: A Symposium of the British Ecological Society on light as an ecological factor, 30 March - 1 April, 1965, Cambridge, Engl., John Wiley and Sons, Inc., New York. Brit. Ecol. Soc. Symp. 6: 359-374. Illus.; Biological Abstracts, 48(17): Abst. No. 84197. 1967.

Information about image transmission and visibility underwater is being used by marine biologists in studies on the ecology and behavior of fish. Visibility depends upon the brightness contrast between the object and its background. The relations governing contrast in different types of water which have been developed by Duntley, are described. The measurement of diffuse and beam attenuation

coefficients necessary for underwater visibility is described. The results of preliminary experiments on the visibility of 5 colored fishing nets in the Mediterranean and in Scottish waters are presented. The results show the significance of brightness contrast and emphasises the necessity for measuring the color and brightness of the water background. Pelagic fish appear to be well camouflaged by the possession of silvery scales set vertically. Most silvery pelagic species are schooling fish and the resultant paradox between the use of vision in schooling and camouflage against a water background is discussed. It is suggested that black spots and stripes may be specific sign stimuli which could resolve this paradox. (Auth.)

9794. Frost, W.E., and M.E. Brown. 1967. THE TROUT. Collins Clear-Type Press, St. James's Place, London, England. 286 p. Illus.

A book on the brown trout covering anatomy, physiology, taxonomy, distribution, life history, age and growth, heredity, physical environment, food, biological environment and management. The eight appendices, long list of references, and index add to the value of the book. Numerous plates, maps and figures fittingly complement the text.

9795. Kirka, Anton (Lab. Rybarstva, Bratislava, Czech.). 1966. CONTRIBUTION TO AGE AND PUBERTY OF THE BROOK TROUT (Salmo trutta m. fario) FROM RIVERS IN THE NORTHERN PART OF SLOVAKIA. Biologia (Bratislava), 21(12): 894-903. (Russ. and Ger. summ.); Biological Abstracts, 48(17): Abst. No. 84201. 1967.

The present contribution gives the age composition of the brook trout from 13 brooks and rivers belonging to the watershed of the rivers Vah and Visla. The number of surviving populations per year and at puberty were investigated. Twenty percent of the males of group I age, spawn at a minimum body length of 111-120 mm. Pubescent females were found in the group II age (32.0%) at a minimum body length of 121-130 mm. (Auth. summ. transl.)

9796. Vasey, Fred W. (Missouri Dept. Conservation, Columbia, Mo.). 1967. AGE AND GROWTH OF WALLEYE AND SAUGER IN POOL 11 OF THE MISSISSIPPI RIVER. Iowa State J. Sci., 41(4): 447-466. Illus.; Biological Abstracts, 48(17): Abst. No. 84224. 1967.

Walleyes, Stizostedion vitreum (Mitchill), and saugers, S. canadense (Smith), were collected with an electric shocker below Lock and Dam 10 in the Mississippi River in April 1957, 1958, 1959, 1961, and 1962 by the Iowa Conservation Commission. Female walleyes and saugers were more abundant than males in the collections except in 1961. Collection at various stages of the spawning period probably caused the variation in sex ratios and length frequencies for different years. Condition factors differed significantly between sexes and species but not between years of collection. The mean condition factors were 41.8 for female walleyes, 36.9 for males, 37.4 for female saugers and 33.7 for males. In each group weight increased more rapidly than the length cubed. Females grew more rapidly than the males after the third year of life. The oldest male walleye was age V compared with age XI females. The oldest female saugers were only 1 year older than the oldest males, age VI. Selective sampling and use of direct proportion for calculating previous lengths were probable causes of Lee's phenomenon. Growth rates of both species in Pool 11 were faster than averages reported in most other waters, but not as rapid as in new reservoirs. (Auth.)

9797. Holeton, G.F., and D.J. Randall (Dept. Zool., Univ. Brit. Columbia, Vancouver, B.C., Canada). 1967. CHANGES IN BLOOD PRESSURE IN THE RAINBOW TROUT DURING HYPOXIA. J. Exp. Biol., 46(2): 297-305; Biological Abstracts, 48(17): Abst. No. 84757. 1967.

Methods for sampling blood and water afferent and efferent to the gills of the unrestrained, unanesthetized, intact teleost fish are described. Pressure measurements at these points and the changes that take place during hypoxia were reported. Breathing rate, amplitude and blood systolic and pulse pressures in the

dorsal and ventral aortae increase during hypoxia. The heart rate decreases. The resistance to blood flow through the respiratory and systemic circulations probably increases during hypoxia. Large temporary increases in blood pressure, which return to resting levels within 90 minutes, occur when the fish is returned to oxygenated water. (Authors)

9798. Barkuloo, James M. (Bureau of Sport Fisheries and Wildlife, Division of Fishery Services, Washington, D. C.). 1967. FLORIDA STRIPED BASS. Florida Game and Fresh Water Fish Comm. Fishery Bulletin No. 4. 24 p. Illus.

Natural distribution and stocking records are given for striped bass in Florida. Lateral-line scale counts from two Florida populations are compared with scale counts of striped bass from other river drainages. Evidence is presented that indicates an increase in the abundance of striped bass in the St. Johns River between 1954 and 1965. Limiting factors in striped bass reproduction are discussed. Hatchery production of the species in Florida was found to be feasible if adequate facilities are provided. (Auth.)

9799. Holeton, G. F., and D. J. Randall (Dept. Zool., Univ. Brit. Columbia, Vancouver, B. C., Canada). 1967. THE EFFECT OF HYPOXIA UPON THE PARTIAL PRESSURE OF GASES IN THE BLOOD AND WATER AFFERENT AND EFFERENT TO THE GILLS OF RAINBOW TROUT. J. Exp. Biol., 46(2): 317-327; Biological Abstracts, 48(17): Abst. No. 85063. 1967.

The rate of O_2 uptake by rainbow trout does not alter during progressive deoxygenation of the environment. The percent utilization of O_2 from water passing over the gills decreases but ventilation volume increases. In the resting fish the arterial blood is 95-100% saturated with O_2, the mixed venous blood is 70% saturated. Carbon dioxide pressure Pco_2 levels are 1-1.5 mm Hg and 2.5 mm Hg in the arterial and venous blood respectively. During hypoxia the percent saturation of the arterial blood was reduced to 37% whereas the percent saturation of the mixed venous blood was only 3%. There were small increases in blood Pco_2 due to the experimental design. The red blood cells swelled during hypoxia, the hematocrit increased but the red blood cell count did not alter. The ability of the fish to withstand hypoxia was augmented by a high blood O_2 capacity. Cardiac output did not change during progressive hypoxia in the water. Stroke volume increased to offset the decrease in heart rate. (Authors)

9800. Randall, D. J., G. F. Holeton, and E. Don Stevens (Dept. Zool., Univ. Brit. Columbia, Vancouver, B. C., Canada). 1967. THE EXCHANGE OF OXYGEN AND CARBON DIOXIDE ACROSS THE GILLS OF RAINBOW TROUT. J. Exp. Biol., 46(2): 339-348; Biological Abstracts, 48(17): Abst. No. 85072. 1967.

The effectiveness of O_2 uptake by the blood of rainbow trout (Salmo gairdneri) approached 100%, whereas that for the removal of O_2 from the water was only of the order of 11-30%. Most of the CO_2 was removed from the blood as it passes through the gills, but the effectiveness of CO_2 uptake by the water was very low, due to the high capacity of water for CO_2 compared with O_2. Moderate exercise had little effect on the effectiveness of gas exchange across the gills. The increased O_2 uptake was facilitated by an increase in the transfer factor of the gills for O_2. There were small increases in the capacity rate ratio of blood to water at the gills during moderate exercise. Hypoxia resulted in a marked decrease in the effectiveness of O_2 uptake by the blood but had little effect on O_2 removal from the water. Gas exchange was facilitated during hypoxia by an increase in transfer factor, but hindered by an increase in capacity rate ratio of blood to water at the gills. Gas exchange in an aquatic environment was compared to that in an aerial environment. (Authors)

9801. Stevens, E. Don, and D. J. Randall (Dept. Zool., Univ. Brit. Columbia, Vancouver, B. C., Canada). 1967. CHANGES OF GAS CONCENTRATIONS IN BLOOD AND WATER DURING MODERATE SWIMMING ACTIVITY IN RAINBOW TROUT. J. Exp. Biol., 46(2): 329-337; Biological Abstracts, 48(17): Abst. No. 85074. 1967.

Changes in partial pressures of O_2 and CO_2 in blood and water, afferent and efferent to the gills of rainbow trout, were determined before, during and after moderate swimming activity. The blood and water samples were obtained with indwelling cannulae in unanaesthetized, unrestrained, intact fish. Neither blood nor water O_2 pressure Po_2 afferent or efferent to the gills changed markedly during exercise. Arterial blood was always greater than 95% saturated with O_2. Venous blood was 38% saturated with O_2, falling to a minimum of 28% saturation during exercise. Arterial blood Pco_2 was 2.3 mm Hg, venous blood Pco_2 increased from 5.7 mm Hg to 8.0 mm Hg during exercise and remained elevated throughout the recovery period. Cardiac output, stroke volume, ventilation volume and the volume of water pumped/breath all increased by a factor of between 4 and 5 during exercise. All tended to remain elevated for between 10 to 30 minutes after exercise and then gradually decreased to pre-exercise levels. (Authors)

9802. Idler, D.R., and H.C. MacNab (Fish. Res. Board Can., Halifax, N.S., Canada). 1967. THE BIOSYNTHESIS OF 11-KETOTESTOSTERONE AND 11β-HYDROXYTESTOSTERONE BY ATLANTIC SALMON TISSUES IN VITRO. Can. J. Biochem., 45(4): 581-589; Biological Abstracts, 48(17): Abst. No. 85196. 1967.

The in vitro synthesis of 11-ketotestosterone and 11β-hydroxytestosterone, from adrenosterone and testosterone, by gonadal and interrenal slices and by sperm was studied. The results establish that adrenosterone is the major precursor of 11-ketotestosterone in both interrenal and testicular tissue. 11β-hydroxytestosterone was synthesized mainly from testosterone by gonadal and interrenal tissue. The production of 11β-hydroxytestosterone by normal gonadal tissue is reported for the first time. (Authors)

9803. Lukowicz, Mathias (Teichwirt. Zool., Inst., Univ., Erlangen/Nurnberg, West Germany). 1966. ON TASTE FIBERS AND LIP EPIDERMIS OF VARIOUS EGYPTIAN FRESH-WATER FISH AND SOME EXPERIMENTS ON THE SENSE OF TASTE. Zool. Anz., 176(6): 396-413. Illus.; Biological Abstracts, 48(17): Abst. No. 85415. 1967.

In 1962 different species of fish of the Nile River were collected and fixed in order to investigate the taste fibers. It concerns the following Cyprinidae: Barbus bynni, Labeo niloticus, Labeo forskalii. Siluridae: Synodontis schall, Bagrus bayad, Bagrus docmac, Chrysichthys auratus. The present paper only describes Barbus bynni and Bagrus bayad. Characteristic for the taste fibers of Cyprinidae is that there are nerve cords and blood vessels in the middle. This central cylinder is surrounded by a ring of fixed connective tissue. To the outside, loose connective tissue and epidermis are attached. The Siluridae taste fiber is characterized by a cartilage cord extending through the middle. Ventrally there is a nerve cord and below that a blood vessel. Taut and loose connective tissue represent the main substance of the tissue. The epidermis is ventrally clearly thickened. There is no musculature in the taste fiber. For the large Siluridae taste fibers, a special movement mechanism is formed at the base. Besides the taste fiber, muscles and flexible bones are playing an important part. The change of shape of the mucus cells and the club cells are described. Gustatory cells and horny cell pads of epithelial cells and strange tubular cells in Bagrus bayad are mentioned. In living animals of Egyptian fish species only short-term investigations were made. Gustatory tests were performed in Kongo sheatfish and dwarf sheatfish, which were kept in an aquarium for a longer period of time. There it was learned, that "sweet" apparently can be tasted by using the taste fibers outside of the mouth, sour and salty are also recognized outside of the mouth using the barbs. The perception of the bitter taste was only possible within the mouth. (Auth. summ. transl.)

9804. Baylor, Edward R. (Woods Hole Oceanogr. Inst., Woods Hole, Mass.). 1967. VISION OF BERMUDA REEF FISHES. Nature, 214(5085): 306-307; Biological Abstracts, 48(17): Abst. No. 85423. 1967.

A comparison can be made of the ranges of refractive errors of open-water fishes (from Baylor and Shaw) with the ranges of refractive errors of reef fishes. The lower limits of the range of refractive error in reef fishes represent essen-

tially emmetropic vision, but the lower limits of refractive error in the alewife and silversides are hypermetropic. Reef fishes are probably better adapted for close-up vision than open-water fishes. (From auth.)

9805. Baylor, Edward R. (Woods Hole Oceanogr. Inst., Woods Hole, Mass.). 1967. AIR AND WATER VISION OF THE ATLANTIC FLYING FISH, Cypselurus heterurus. Nature, 214(5085): 307-309; Biological Abstracts, 48(17): Abst. No. 85424. 1967.

The flying fish has a dual purpose cornea which permits a fraction of the hypermetropic underwater vision found in other open-water fishes but, nevertheless, assures emmetropic vision in air. (From auth.)

9806. Witkovsky, Paul (Coll. Physicians and Surg., New York, N.Y.). 1967. A COMPARISON OF GANGLION CELL AND S-POTENTIAL RESPONSE PROPERTIES IN CARP RETINA. J. Neurophysiol., 30(3): 546-561; Biological Abstracts, 48(17): Abst. No. 85457. 1967.

A comparison of carp retina S-potential and ganglion cell response properties was effected using spectral sensitivity, light- and dark-adaptation, threshold and increment threshold functions as the bases for the comparison. Three S-potential spectral response curves were isolated in the photopic retina: one L-(luminosity) potential and two C-(chromatic) potentials. The L-potential spectral sensitivity curve had 2 peaks near 613 and 665 mμ. No further isolation of subpeaks was possible. After dark-adaptation, the L-potential became relatively more sensitive in the blue and less so in the far red. C-potential sub-components with maxima near 482, 572, 665 mμ and 520,550, 665 mμ were isolated after suppression of the remaining components by exposure to colored adapting lights. In the light-adapted state, ganglion cell "on" or "off" units peaked near 613 mμ but could be fractionated into sub-components by selective adaptation. Wave-length-dependent "on-off" units exhibited 2 peaks near 482 and 613 mμ. Spectral sensitivity of dark-adapted units followed the rod pigment curve whose absorption peak lies at 523 mμ. Ganglion cells had 2-3 log unit lower thresholds than did S-potentials in either state of adaptation. The response-intensity function rose to a peak, then declined for the ganglion cell, but rose monotonically for the S-potential. In increment threshold measurements, the ganglion cell was sensitive to weaker background fields than was the L-potential and continued to fire after the L-potential had saturated with strong background fields. Ganglion cells respond independently of S-potentials for the stimulus parameters tested. (Auth.)

9807. O'Sullivan, A.J., and Alison J. Richardson (Lancashire and West. Sea Fish., Preston, Lancashire, England). 1967. THE TORREY CANYON DISASTER AND INTERTIDAL MARINE LIFE. Nature, 214(5087): 448, 541-542; Biological Abstracts, 48(17): Abst. No. 85892. 1967.

The mixture of emulsified oil and detergent is far more toxic than the oil itself. Two theoretical considerations would seem to lend support to this view. First, all or nearly all detergents are themselves toxic; second, once the oil is emulsified it ceases to become merely a surface layer and becomes instead an actual part of the aqueous environment where it may be taken into the gills of fish or ingested by filter-feeding organisms, etc. Thus where littoral marine life is concerned, the use of detergents constitutes a "cure" worse than the "disease" itself. (Authors)

9808. Sterba, G., C. Pfister, and W. Naumann (Zool. Inst., Karl-Marx Univ., Leigzig, East Germany). 1965. ON THE BEGINNING OF NEUROSECRETION AND THE SECRETION OF SUBCOMMISURAL ORGANS IN LAMPREY EMBRYOS. Z. Mikroskop. Anat. Forsch, 74(1): 33-38. Illus.; Biological Abstracts, 48(17): Abst. No. 86196. 1967.

Neurosecretion begins in 7.5 to 8 mm long embryos in Lampetra planeri at various centers of the hypothalamus. The secretion of the subcommisural organ begins somewhat earlier. Although lampreys represent the most primitive vertebrates, the morphological situation relative to the onset of neurosecretion in the hypothalamus shows no similarity to the condition in acraniates. --S. Wishnitzer.

9809. Shcherban', N. P. 1965. USE OF FILIKSAN AND PHENOTHIAZINE IN Bothriocephalus INFESTED FISH. Ryb. Khoz. Respub. Mezhvedom. Temat. Nauch. Sb., 2. 141-144. From: Ref. Zh., Biol., 1966, No. 10K139; Biological Abstracts, 48(17): Abst. No. 87225. 1967.

Filiksan (dry Aspidium filix mas extract) possesses high anti-cestode properties and may be used successfully for individual worming of fish. A 1% suspension of Filiksan in a 2% starch paste causes the death of the parasites with the subsequent elimination of the organism. A single-dose introduced into the intestine of the fish of 500 to 3,000 mg of Filiksan has no toxic effects. Only mature cestodes die from Filiksan; the larvae of Bothriocephalus are resistant to the drug. For complete restoration of the health of a flock of valuable fish, worming should be performed by combining Filiksan with phenothiazine.

9810. Corkum, Kenneth C. (Louisiana State Univ., Dept. Zool. and Physiol., Baton Rouge, Louisiana). 1966. THE DIGENETIC TREMATODES OF SOME FLATFISHES FROM BARATARIA BAY, LOUISIANA. Proc. Louisiana Acad. Sci., 29(1): 45-51; Biological Abstracts, 48(17): Abst. No. 88186. 1967.

Of the six spp. of flatfishes from Barataria Bay, Louisiana, three were found to be free of trematode infections. In the remaining three spp., Paralichthys lethostigma harbored six spp. of trematodes, three Trinectes maculatus and one metacercarial form of Symphurus plagiusa. (Auth.)

9811. Kollmann, Albert (Zoll. Inst., Univ. Erlangen-Nurnberg, Erlangen-Nurnberg, West Germany). 1966. Dactylogyrus extensus Mueller et v. Cleave, 1932 (TREMATODA, MONOGENOIDEA) ON CARPS SEEN FOR THE FIRST TIME IN WESTERN GERMANY. Zool. Anz., 177(5/6): 426-434. Illus. (Engl. summ); Biological Abstracts, 48(17): Abst. No. 88193. 1967.

A research on Dactylogyrus extensus was carried out on 250 carps from ponds of Northern Bavaria. Prevalence of infection amounted to 100% and up to 55 specimens were found per fish. D. extensus always ranged together with D. vastator in July and could be kept in aquarium for 7 months. One can roughly estimate the intensity of infection from the state of health of fishes. The development of the eggs of D. extensus takes 5 days at a temperature of 20° C. The development to maturity takes 6-10 days. The parasite cannot only handicap the respiration of the fish but can also cause pulvinate hypertrophy and secretion of mucus. Sufficient measures against the parasite are fullfilled when the fish are set out in a large area with relatively high quantities of natural food. (Authors)

9812. Myers, Betty June, and Robert E. Kuntz (Div. Microbiol. and Infect. Dis., Found. Res. and Educ., Southwest San Antonio, Texas). 1967. NEMATODE PARASITES OF FISHES TAKEN ON TAIWAN (FORMOSA) AND ITS OFFSHORE ISLANDS. Can. J. Zool., 45(4): 237-241; Biological Abstracts, 48(17): Abst. No. 88195. 1967.

The present report is one of a series concerned with the helminths of vertebrates taken on Taiwan and its Offshore Islands. Nematodes are listed for fishes (mostly marine) examined over a 5-year period (1957-1962). (Authors)

9813. Food and Agriculture Organization of the United Nations (Food Agr. Organ. U.N., Rome, Italy). 1966. WORLD LIST OF PERIODICALS FOR AQUATIC SCIENCES AND FISHERIES. FAO Fish. Tech. Pap. No. 19, Vol. 1, Suppl. 3. pp. 1-43; Biological Abstracts, 48(18): Abst. No. 88698. 1967.

Lists, in alphabetical order, titles and short forms of current periodicals as well as those which ceased publication since the printing of Vol. 1 and Suppl. 1 and 2. Includes translation of original titles occasionally met in bibliographies. (Authors)

9814. Dijkgraaf, S., and A. J. Kalmijn (Inst. Vergleichende Physiol. Univ. Utrecht, Utrecht, Netherlands). 1966. EXPERIMENTS ON THE BIOLOGICAL IMPORTANCE OF THE AMPULLAE OF LORENZINI IN ELASMOBRANCHII. Z. Vergleichende Physiol., 53(3): 187-194. Illus. (Engl. summ.); Biological Abstracts, 48(18): Abst. No. 89274. 1967.

On stimulation of Raja clavata with square wave electric potential changes (frequency: 5 periods/sec) and with the heart-beat frequency as an indicator, a threshold of 0.01μV/cm sea-water was determined. This value is notably lower than the threshold determined earlier with the use of other reactions A ray can respond to the movements of a flatfish and other animals merely by preception of the accompanying muscle potentials with the ampullae of Lorenzini Both sharks and rays can be conditioned with food to electric stimuli emanating from electrodes that are hidden under the sand. The animals are able to localize the source of electric stimulation. Nerve impulses from a bundle of fibers innervating Lorenzinian ampullae of a dogfish (Scyliorhinus canicula) were recorded by the use of an implanted electrode, connected to the nerve in situ without opening of the tissue surrounding the ampullae concerned, and with the animal swimming quietly and freely around. Clear responses were recorded on weak electrical stimuli—including the animal's own breathing potentials—but no response whatever occurred on mechanical stimulation. The results support the hypothesis that the Lorenzinian ampullae are used as electroreceptors and not at all as mechanoreceptors. They also show that these sense organs might indeed be used to perceive other animals on the basis of spread muscle potentials. (Authors)

9815. Haynes, L. J., A. W. Sangster, D. M. Steven, and Shirley Thomas (Dept. Chem., Univ. West Indies, Kingston, Jamaica). 1967. CHEMICAL FACTORS INDUCING EXPLORATORY FEEDING BEHAVIOUR IN FISH INDUCING PROPERTIES OF MARINE INVERTEBRATES. Comp. Biochem. Physiol., 20(3): 755-765. Illus.; Biological Abstracts, 48(18): Abst. No. 89281. 1967.

A method which gives a high degree of reproducibility is described for recording exploratory feeding behavior (E. F. B.) to chemostimulation in fish. Exploratory feeding behavior was evoked by extracts of all of 10 species of marine invertebrates selected from 5 phyla. Extracts of the outer test of Ascidia nigra evoked an avoidance response, indicating that it contains a noxious substance that may be important in protecting this species from predators. Chemical analyses indicate that E. F. B.-inducing substances are of a similar nature in all species tested and are probably amino-like. Pure amino acids, including some aminophosphonic acids, do not evoke E. F. B. (Authors)

9816. Gibson, R. N. (Mar. Sta., Millport, Scotland). 1967. EXPERIMENTS ON THE TIDAL RHYTHM OF Blennius pholis. J. Mar. Biol. Ass. U. K., 47(1): 97-111. Illus.; Biological Abstracts, 48(18): Abst. No. 89378. 1967.

The endogenous tidal rhythm of the littoral fish Blennius pholis L. was studied in the laboratory. It was found that there was no difference in the mean level of activity of fish caught on spring and neap tides. The time-interval between activity peaks (the length) gradually increased in constant darkness. A similar, although not significant, increase was also observed in continuous illumination. There was no evidence of any diurnal component in the rhythm, but freshly caught fish subjected to alternating periods of light and darkness, equal in duration to the natural period, responded to the onset of illumination by greatly increased activity only when the light period began between activity peaks. Fish which had been kept in the laboratory for several weeks and had lost their natural rhythm still responded to light by increased activity. This increase was not as great as that shown by freshly caught fish, however, and the response decreased with time. Evidence of re-entrainment of the natural rhythm after 7 days in alternating periods of light and darkness was not found. It was shown that feeding the fish half-way through the 12 h light-period resulted in a reduction of activity after feeding. This did not occur when the fish were fed half-way through the dark period. A 4 h cold shock of 10° C resulted in partial re-entrainment of rhymthic activity in B. pholis. B. pholis, which alone appears to have a persistent rhythm, differs from certain other fish examined in its strictly littoral habitat and its possible need for activity periods synchronized with the tide. (Auth.)

9817. Pechlaner, R. 1964. PLANKTON PRODUCTION IN NATURAL LAKES AND HYDRO-ELECTRIC WATER-BASINS IN THE ALPINE REGION OF THE AUSTRIAN ALPS. In: 15th Congress of the Societas Internationalis Limnologiae, Madison, Wis., 20-25 August, 1962. Int. Ver. Theor. Angew. Limnol. Verh., 15(Pt. 1): 375-383. Illus.; Biological Abstracts, 48(18): Abst. No. 89478. 1967.

All hydroelectric water basins studied contain remarkably high quantities of zooplankton (excluding alpine basin Mooserboden in Kaprun); values of 320 and 1,600 mg freshweight per m^3 were found in basins containing no fishes. There is a high annual loss of plankton in water withdrawn for electric power. In Amersee and Wiessee the losses of zooplankton for 1961 were calculated to be 1.4 and 25 t respectively. Primary production by phytoplankton plays at least an essential role in the nutrition of the zooplankton: values of 1,500 and 1,600 mg/m^3 phytoplankton were found in autumn in Lunersee and Weissee. Very low crops, between 26 and 100 mg/m^3, were still present in basins in the "Hohen Tauern" in April, in the period of reproduction of the dominant Copepoda. Primary production in Lunersee in July was 41 mg C/m^2, with a mean phytoplankton fresh weight of 290 mg/m^3. (Auth.)

9818. De Sylva, Donald P., Frederick A. Kalber, and Carl N. Shuster, Jr. 1962. FISHES AND ECOLOGICAL CONDITIONS IN THE SHORE ZONE OF THE DELAWARE RIVER ESTUARY WITH NOTES ON OTHER SPECIES COLLECTED IN DEEPER WATER. University of Delaware Marine Laboratory Information Series. Publication No. 5. ii+164 P. Illus. Delaware Board of Game and Fish Commissioners, Univ. of Delaware: Newark, Del.; Biological Abstracts, 48(18): Abst. No. 89502. 1967.

Information was collected during the period August 1958 to February 1960, concerning the distribution of fishes in the shore zone in relation to the various environments found at 16 sites within the Delaware River estuary and adjacent areas of the Atlantic coast. Over 54,000 fishes comprising 66 spp. were collected in the shore zone. Data were occasionally collected concerning the presence of these 66 spp. in the deeper waters of the estuary as well as the occurrence of 72 spp. not caught in the beach zone area. Measurements of salinity, temperature, oxygen saturation, and turbidity of the water were taken at the time of fish collection. Observations of tide condition, plant associations, bottom type and associated animals were also made at the collection sites. A critical analysis of the relationship of these fishes to their environment has not been made, but the investigation provided an opportunity to delineate the parameters of the conditions under which these species are found. Many forms such as Pomatomus saltatrix, Leiostomus xanthurus and Cynoscion regalis were found over a wide range of salinity, temperature, and oxygen saturation values extending far up the estuary. Other fishes, such as Trachinotus carolinus and T. falcatus, seemed to be restricted in their distribution with respect to these factors, and these species were found only in the lower part of Delaware Bay. The least amount of correlation was found between fish distributions and turbidity. Heavy spawning activity seemed to be associated with several nearshore areas of the estuary. Our shore zone sampling areas, ranked in order of decreasing affiliation with spawning, were: Augustine Beach, Salem, Woodland Beach, Cape May, Lewes, Slaughter Beach, Fortesque, Moore's Beach, Cohansey River mouth, Reed's Beach, Bower's Beach, Great Egg Harbor, Townsend's Inlet, and Penn's Grove. The reproductive condition of specimens collected in these and other areas indicated a sequential spawning of both resident and non-resident species. Spawning periods for many of the species that were tolerant of low salinity waters seemed to be correlated with the time at which the adults of these species were found in the shore zones of the upper Bay. Stomach analyses showed that at least 41 of the species studied were feeding heavily on small fishes (Anchoa mitchilli, Menidia spp.) and/or on benthic invertebrates. Areas supporting luxuriant growths of intertidal plants yielded great numbers of the small forage fishes and invertebrates. These areas were also found to be the areas richest in juvenile fish, indicating the value of such zones as nursery grounds. (Authors)

9819. Harvey, H. H. 1964. DISSOLVED NITROGEN AS A TRACER OF FISH MOVEMENTS. In: 15th Congress of the Societas Internationalis Limnologiae, Madison, Wis., 20-25 August, 1962. Int. Ver. Theor. Angew. Limnol. Verh., 15(Pt. 2): 947-951. Illus.; Biological Abstracts, 48(18): Abst. No. 89511. 1967.

Sockeye smolts migrating out of Cultus Lake after the lake has stratified thermally, show a marked propensity to gas embolisms following sudden pressure reduction below atmospheric conditions. This state of the fish is associated with some period of residence in the lake at the depth of the thermocline or greater. Individual fish change temperature more rapidly than they equilibrate with the N of their environment. In late-migrating smolts, moving upward rapidly from the thermocline to the lake surface, the N content of the fish would approach 130% of air saturation. N equilibration between fish and environment is too rapid for dissolved N to account for the slowly disappearing lethal factor shown by the late-migrating smolts. Bladderless fish and smolts with catheterized swimbladders are less prone to such embolisms on pressure reduction. No difference was found in the ease of passage of gas through the pneumatic duct for surface and depth-held fish. No change in the swimbladder was observed such as to explain the seasonal change in mortality. (Auth.)

9820. Maar, A., M. A. E. Mortimer, and I. Van der Lingen. 1966. FISH CULTURE IN CENTRAL EAST AFRICA. xiii+158 p. Illus. Food and Agriculture Organization of the United Nations: Rome, Italy; Biological Abstracts, 48(18): Abst. No. 89523. 1967.

In most African countries the importance of fish culture has not been fully recognized and its development has not been pursued, mainly because of a lack of fisheries organizations and a shortage of professional and trained staff. Another hindrance is the small amount of educational material and instructional booklets related to local conditions. As part of its applied nutrition program in Africa in conjunction with FAO and WHO, UNICEF has sponsored a number of manuals aimed at the improvement of nutritional standards. This manual of fish culture is one of the series and presents the essentials of fish culture to the farmer or land-owners wishing either to raise fish for the family alone or to enter a commercial venture and produce fish for sale in the market. It may also serve as a text for training extension workers and others to help in promoting fish culture in their areas. Since a large part of the protein now lacking in the diets of many African families could be supplied by fish, a fuller and more widespread development of fish culture must be encouraged.

9821. Morawa, F. W. Frithjof. 1964. SOME OBSERVATIONS ON THE STORAGE OF FAT AND THE NUTRITION IN SALMONIDAE. In: 15th Congress of the Societas Internationalis Limnologiae, Madison, Wis., 20-25 August, 1962. Int. Ver. Theor. Angew, Limnol. Verh., 15(Pt. 2); 952-958. Illus.; Biological Abstracts, 48(18): Abst. No. 89527. 1967.

9822. Magnin, Etienne. 1964. LENGTHWISE GROWTH OF THREE STURGEONS FROM NORTH AMERICA: Acipenser oxyrhynchus Mitchill, Acipenser fulvescens Raffinesque AND Acipenser brevirostris LeSueur. In: 15th Congress of the Societas Internationalis Limnologiae, Madison, Wis., 20-25 August, 1962. Int. Ver. Theor. Angew. Limnol. Verh., 15(Pt. 2): 968-974. Illus.; Biological Abstracts, 48(18): Abst. No. 89524. 1967.

9823. Turdakov. A. F. 1965. SELECTIVITY OF FERTILIZATION ON EGGS OF TWO FISH SPECIES EXPOSED TO MIXED SPERM. In: Biological studies on Lake Issyk-Kul. Frunze. 58-75. From: Ref. Zh., Biol., 1966, No. 6I113. (Translation); Biological Abstracts, 48(18): Abst. No. 89544. 1967.

Fertilization of eggs of scaleless osman (Dipthychus dybowskii) and Issyk-Kul chebachok (Leuciscus bergi) was carried out by the dry and semi-dry methods, using various sperm mixtures (75% osman + 25% chebachok, 25% osman + 75% chebachok and 96% osman + 4% chebachok). With fertilization of osman eggs by the dry method, the percentage of eggs fertilized by the sperm of scaleless osman and

chebachok corresponded to the proportions of their spermatozoa in the mixtures, i.e., no selective fertilization was observed. Dilution of the sperm with water in a ratio of 1:5 resulted mainly in the fertilization of the eggs of both species by chebachok sperm. In mixtures with chebachok sperm fertilized by the dry method, fertilization was also mainly by chebachok sperm. Observations on the mobility of sperm in pure suspensions and in mixtures, and study of their behavior in heterologic sperm plasma, as well as observations on the fertilization of spawn by sperm kept for different periods in the plasma, failed to explain selective fertilization. The role of the ovarian fluid was investigated. Sperm of both species remained immobile in the ovarian fluid of scaleless osman; the ovarian fluid of chebachok activated the movements of chebachok sperm 100%, and of scaleless osman sperm 10%. Addition of water to the milt increased the mobility of the scaleless osman sperm to 50% in the ovarian fluid of chebachok, and only by 5% in the ovarian fluid of scaleless osman. The mobility of chebachok spermatozoa in chebachok ovarian fluid remained unchanged, whereas in the ovarian fluid of the other species it rose to 80%. Fertilization of eggs by chebachok sperm is explained by the difference in the activity of the different spermatozoa in the ovarian fluids of the fishes investigated. This conclusion is confirmed by the disappearance of the dominant effect of chebachok sperms after the removal of ovarian fluid from the eggs. Under these conditions selective fertilization of eggs by the sperm of a particular species is dependent upon the degree of sperm activity characteristic of the species.

9824. Van Coillie, Raymond (Dept. Biol., Univ. Laval, Laval, Que., Canada). 1967. STUDY WITH THE AID OF TETRACYCLINES OF THE PERIODIC GROWTH OF SCALES OF TELEOSTOMES. Natur. Can., 94(1): 29-58. Illus. (Engl. summ.); Biological Abstracts, 48(18): Abst. No. 89546. 1967.

Tetracyclic bone markers are used for studying scale growth of Tilapia melanopleura a fish from equatorial Africa. These markers, commonly used with higher vertebrates, have been found most useful contrary to lead acetate which is apparently toxic for this fish. Young tilapia were kept in aquaria under constant and favorable "light" and "energy" factors: growth of their body and scales depends on the "temperature" factor which in turn influences the thyroid gland. Growth of the anterior portion of the scales is superior to that of the remaining zones; it may increase while these latter zones remain constant in size. A temperature decrease from 25 to 15° C of the water for a period of 1 month does not give rise to the formation of an "annullus". (Auth.)

9825. Walters, Vladimir (Dept. Zool., Univ. Calif., Los Angeles, Calif.). 1966. THE "PROBLEMATIC" HYDRODYNAMIC PERFORMANCE OF GERO'S GREAT BARRACUDA (Sphyraena barracuda (Walbaum)). Nature, 212(5058): 215-216. Illus.; Biological Abstracts, 48(18): Abst. No. 89637. 1967.

Using a revised estimate of the mass of propulsive musculature and a power factor more in keeping with the habitat temperature of the fish, the measured performance of the burst swimming speed of the great barracuda is as expected. (From auth.)

9826. Smit, H. (Zool. Lab., Univ. Leiden, Leiden, Netherlands). 1967. INFLUENCE OF TEMPERATURE ON THE RATE OF GASTRIC JUICE SECRETION IN THE BROWN BULLHEAD, Ictalurus nebulosus. Comp. Biochem. Physiol., 21(1): 125-132. Illus.; Biological Abstracts, 48(18): Abst. No. 89898. 1967.

Brown bullheads (Ictalurus nebulosus) were kept at various acclimation levels from 10° to 30° C. Gastric secretion was evoked by inserting into the stomach a piece of sponge. The composition of the gastric juice was found to depend on the rate of secretion, the latter being temperature dependent. Gastric juice output was strongly affected by temperature deviations from the acclimation level. The rate of secretion showed compensation for temperature changes within the acclimation range between 20° and 30° C. (Auth.)

9827. Hardisty, M. W., B. Rothwell, and K. Steele (Bath Univ. Tech., Sch. Biol. Sci., Bath, England). 1967. THE INTERSTITIAL TISSUE OF THE TESTIS OF THE RIVER LAMPREY, Lampetra fluviatilis. J. Zool. Proc. Zool. Soc. London, 152(1): 9-19. Illus.; Biological Abstracts, 48(18): Abst. No. 90368. 1967.

The cytology of the interstitial cells of the testis of the river lamprey has been studied from the autumn when the upstream migration begins up to the completion of sexual maturation in the following spring. In the early stages of spermatogenesis the interstitial tissue consists of isolated interlobular connective tissue cells. During the winter these appear to increase in numbers and form compact groups sometimes showing an acinar type of structure. In the earlier stages of the secretory cycle the cytoplasm contains small osmiophilic and sudanophilic granules, which appear to aggregate to form much larger lipid positive masses. In the later stages of spermatogenesis in early spring, the interstitium accumulates large areas of lipid and cholesterol positive droplets and in fixed material the cytoplasm shows extensive vacuolization. In the terminal stages the cells undergo complete disintegration. It seems probably that the stage when the interstitium shows masses of lipid and cholesterol positive droplets represents a phase of degeneration and that the secretion of hormone occurs in earlier stages. No convincing evidence has been obtained for the presence of the enzyme steroid-3β-ol-dehydrogenase during the later stages of the secretory cycle. There is evidence that following the degeneration of the interstitium there may be a replacement of the secretory tissue by the transformation of residual connective tissue elements, which may then re-enter the secretory phase. The changes in the interstitium are paralleled by hypertrophy and evidence of lipid metabolism in the modified fibroblasts of the lobular wall and this tissue may also be involved in the secretory activity of the testis. (Authors)

9828. Fagerlund, U. H. M. (Fish. Res. Board Can., Vancouver Lab., Vancouver, B. C., Canada). 1967. PLASMA CORTISOL CONCENTRATION IN RELATION TO STRESS IN ADULT SOCKEYE SALMON DURING THE FRESHWATER STAGE OF THEIR LIFE CYCLE. Gen. Comp. Endocrinol., 8(2): 197-207. Illus.; Biological Abstracts, 48(18): Abst. No. 90394. 1967.

The concentration of cortisol in plasma of adult sockeye salmon (Oncorhynchus nerka) during the freshwater stage of the life cycle was below 5 μg/100 ml when the fish were resting in captivity. Results to date indicate that the same is true of resting salmon in their natural habitat. Handling of fish, physical exercise and disease produced highly increased cortisol concentrations. Sexual maturation and spawning did not induce sustained increases in healthy fish. Death was associated with high cortisol concentrations. Concentrations in a group of chinook salmon (Oncorhynchus tschawytscha), as in sockeye, increased when the fish approached death, but were in general higher than those in sockeye under comparable conditions. (Auth.)

9829. Arai, Ryoichi, and Bun-ichi Tamaoki (Nat. Sci. Mus., Veno, Tokyo, Japan). 1967. STEROID BIOSYNTHESIS IN VITRO BY TESTES OF RAINBOW TROUT, Salmo gairdneri. Gen. Comp. Endocrinol., 8(2): 305-313. Illus.; Biological Abstracts, 48(18): Abst. No. 90408. 1967.

After incubation of progesterone-4-C^{14} with the testicular homogenate of rainbow trout (Salmo gairdneri), radioactive 17α-hydroxyprogesterone, 17α,20β-dihydroxypregn-4-en-3-one, androst-4-ene-e, 17-dione and testosterone were obtained as metabolites of progesterone. Testosterone, 11β-hydroxytestosterone and 11-ketotestosterone were confirmed as metabolites of androst-4-ene-3, 17-dione-4-C^{14} by the fish testicular homogenate, but neither 11β-hydroxyandrost-4-ene-3, 17-dione nor adrenosterone was detected as its metabolite. The incubation products were respectively identified by their mobilities on thin layer chromatograms, chemical characteristics in comparison with the corresponding authentic preparations, and finally on the basis of constant specific activities throughout repeated crystallizations with respective reference preparations. These studies demonstrated the presence of 17α-hydroxylase, 20β-hydroxysteroid dehydrogenase 11β-hydroxylase and 11β-hydroxylase and 11β-hydroxysteroid dehydrogenase in rainbow trout testes. The biosynthetic studies suggest a pathway of testosterone

formation from progesterone in the testicular tissue of this fish similar to that which is reported for mammalian testes. However, rainbow trout testes furthermore forms 11-ketotestosterone from androst-4-ene-3, 17-dione probably through testosterone and 11β-hydroxytestosterone, which sequence of bioconversion was not observed for normal mammalian testes. (Authors).

9830. Klein, Catherine (Fac. Sci., Univ. Strasbourg, Strasbourg, France). 1967. STUDY OF THE DEVELOPMENT OF THE HYPOTHALAMO-HYPOPHYSIAL SYSTEM IN THE SALMON Salmo salar L. Gen. Comp. Endocrinol., 8(2): 368-377. Illus.; Biological Abstracts, 48(18): Abst. No. 90456. 1967.

Neurosecretion in the salmon (Salmo salar), living under normal conditions, first appears on the day of hatching in the neurohypophysis, on day 5 hatching in the preoptic necleus (NPO), and on day 15 in the hypothalamo-hypophysial tract (TPOH). The neurosecretory cells first appear along a dorsal antero-posterior area, and then more and more ventrally in the walls of the third ventricle. The neurohypophysis begins to invade the adenohypophysis, but even at the 4-month stage it is not possible to speak of a neuro-intermediate lobe, as there is no interpenetration between the two areas. Two neurosecretory regions may be distinguished in relation to the amount of stainable material; the significance of this feature is discussed. After treatment of the animals by thyroid hormones and antithyroid substances, it was not possible to detect any cytological effect on the first appearance or on the development of neurosecretory activity. (Auth.)

9831. Ueda, Kazuo, Toshiaki J. Hara, and Aubrey Gorbman (Gac. Sci., Univ. Tokyo, Tokyo, Japan). 1967. ELECTROENCEPHALOGRAPHIC STUDIES ON OLFACTORY DISCRIMINATION IN ADULT SPAWNING SALMON. Comp. Biochem. Physiol., 21(1): 133-143. Illus. Map.; Biological Abstracts, 48(18): Abst. No. 90564. 1967.

When the nasal sac of spawning salmon is irrigated with water from the spawning site a high amplitude electroencephalographic response of characteristic pattern may be recorded from the olfactory bulb. This electrical response is specific in the sense that it cannot be evoked by water from spawning sites of other groups of breeding salmon. Weaker, but clear responses could be evoked by waters traversed by the fish migrating toward the spawning site, from the bypassed branch of a stream near the spawning site and from a point upstream of the spawning site. (Authors)

9832. Kawazu, Kazuyoshi, Makoto Inaba, and Tetsuo Mitsui (Dept. Agr. Chem., Kyoto Univ., Kyoto, Japan). 1967. STUDIES ON FISH-KILLING COMPONENTS OF Callicarpa candicans. PART I. ISOLATION OF CALLICARPONE AND ITS TOXICITY TO FISH. Agr. Biol. Chem., 31(4): 494-497. Illus.; Biological Abstracts, 48(18): Abst. No. 90927. 1967.

A fish-killing component, which was named callicarpone, $C_{20}H_{28}O_4$, m.p. 111° C, $[\alpha]_D^{23}$ – 188° (chloroform) was isolated from the leaf of Callicarpa candicans and was found to have conjugate carbonyl groups, double bond and one hydroxyl group. The toxicity to fish was evaluated to be as strong as rotenone and 10 times stronger than sodium pentalchlorophenoxide. (Authors)

9833. Kawazu, Kazuyoshi, Makoto Inaba, and Tetsuo Mitsui (Dept. Agr. Chem., Univ. Kyoto, Kyoto, Japan). 1967. STUDIES ON FISH-KILLING COMPONENTS OF Callicarpa candicans. PART II. STRUCTURE OF CALLICARPONE. Agr. Biol. Chem., 31(4): 498-506. Illus.; Biological Abstracts, 48(18): Abst. No. 90928. 1967.

It was deduced from the spectral data of callicarpone (I), the tetraol (IV), the chlorohydrin (VII) and the anhydro-diacetyl derivative (II) that I was a tricarbocyclic diterpene having an ene-1, 4-dione and an α-hydroxyisopropyl attached to an oxide ring. The structure of the rearranged product obtained by treatment with sodium carbonate was established to be IX by converting it to 11-methoxy-ferruginol methyl ether. As this rearrangement was assumed to be initiated by proton abstraction by base, the structure I was required for callicarpone to explain the formation of IX. (Authors)

9834. Shirahata, Soichiro. 1966. EXPERIMENTS ON NITROGEN GAS DISEASE WITH RAINBOW TROUT FRY. Freshwater Fish. Res. Lab. Bull., 15(2): 197- 211. Illus. (In Jap. with Engl. summ); Biological Abstracts, 48(18): Abst. No. 90953. 1967.

This paper dealt with gas-bubble disease of rainbow trout fry, which was experimentally caused by the water containing excess of nitrogen gas. Careful observations were attempted on the symptoms of the disease for about 2 months after hatching. The content of N gas of experimental water was controlled by aerating the running water which originally contained 165% N saturation. The tolerance of trout fry to the excess of N gas was considerably high for the early half of the period from hatching to swimup, and the tolerance decreased with the development of fish. Various types of symptoms were observed with the development of fish and seemed to depend on the morphological change and the change in activity of fish. The symptoms were classified into 3 types: gas-bubbles adhered on the surface of fish, gas-bubbles formed in internal medium and the intermediate of the above 2. The first type of symptoms developed in the period from hatching to a few days after initial feedings, and was characteristic in their swimming modes, governed by the place where gas-bubbles adhered. The second type was characterized by the gas-bubble formation in circulatory systems. The intermediate type of symptoms was observed at the stage of about 3 weeks after initial feeding. The composition of gas which abnormally accumulated in abdomens was similar to that of small gas-bubbles in rearing water and of the atmosphere. The composition was rather constant and the oxygen content was slightly lower than that of the atmosphere. Thus, it seems that the gas in abdomens may originate from the free gas-bubbles in water. Affected fry, even with extremely distended abdomens filled with gass, could recover within a few days after they were transferred into the water containing normal levels of N gas. It is possible to make early diagnosis of gas disease by examining whether gas-bubbles adhere on the surface of fish body, especially on the fins, a few minutes after exposing fish to new water. This phenomenon was observed on the body of fish younger than about 5 weeks after initial feeding, in the water containing more than about 120% N gas. In addition, when the fish which are kept in a new circumstance exhibit rushing, whirling, and spasmodic movements and die, it is desirable to examine carefully whether gas-bubbles are seen in the bulbus arteriosus and ventricles of heart. (Author).

9835. Emel'yanov, S.V. 1965. HETEROGENEITY OF NEWLY HATCHED LARVAE OF STURGEONS AND BONY FISHES, OBTAINED FROM THE EGGS OF A SINGLE FEMALE. In: Theoretical bases of fish culture. Nauka: Moscow. 187-204. From: Ref. Zh., Biol., 1966, No. 11113. (Translation); Biological Abstracts, 48(18): Abst. No. 91305. 1967.

The hatching process and the state of newly hatched larvae characterize to a significant extent the entire preceding developmental period. Moreover, all subsequent development is determined by the condition of larvae at the time of hatching. Hatching studies were carried out with sturgeons and bony fishes (perch and bleak). In addition to determining total length, observations were made on variations in body proportions of larvae and embryos hatched at different times, on fin-fold structure, on rudimentary pectoral fins, olfactory organs, eyes, acoustic vesicles and circulatory system. The median length of developing embryos increases gradually throughout the hatching period. Within each hatching period the variations in the length of embryos as well as differences in structure, are comparatively small. Structural differences become fairly distinct among embryos of different and particularly terminal periods of development. Larvae that emerge from the egg last may be at different stages of development in comparison with those that emerge first. The time of hatching of a particular embryo is determined by the degree of maturation of the hatching glands, by the amount of enzymes secreted by them, by the thickness and condition of egg membranes, and by the degree of activity of the embryo itself.

9836. Guelin, Antonina, and Daniele Lablin (Inst. Pasteur, Serv. Bacteriophage, Paris, France). 1964. THE SURVIVAL OF BACTERIA AND PSYCHROTROPHIC BACTERIOPHAGES IN THE DIGESTIVE TUBES OF TROUT. Ann. Inst. Pasteur Lille 15: 207-211. Illus. (Engl. summ.); Biological Abstracts, 48(18): Abst. No. 91544. 1967.

The survival of bacteria and psychrotrophic phages introduced into the digestive tube of young trout (not more than 48 hours old) was studied. The curve of the disappearance of these bacteria resembles that of Shigella paradysenteriae. The short survival of the bacteria with different optimum growth temperature (20° C and 37° C) suggests that the inadaptability of the usual bacteria growing at 37° C to develop under the conditions of a cold-blooded animal is not due to the incompatibility of their growth temperature with that of the host. The rapid disappearance of bacteria may be due to the intense secretion and massive penetration of leucocytes in the digestive tube of the fish during digestion. (Authors)

9837. Prost, Maria, and Maria Studnicka (Ul. Akademicka, 11, Lublin, Poland). 1966. INVESTIGATIONS ON THE USE OF ORGANIC ESTERS OF PHOSPHORIC ACID IN THE CONTROL OF EXTERNAL PARASITES OF FARMED FISH: I. CONTROL OF THE INVASION OF Piscicola geometra L. Med. Weter., 22(6): 321-330. (Russ., Engl., Ger., and French summ.); Biological Abstracts, 48(18): Abst. No. 93232. 1967.

For these investigations 3 preparations of the following names were used: Chlorofos (Chinese), Neguvon (Bayer), and Trichlorphon (Wolfen). Before these products were used in treatment, experimental trials were carried out on the reaction of the young of carp, K_0, K_1, and K_2, to different concentrations of these preparations at different times and different temperatures. Observations were also made of the action of these preparations on leeches in vitro. For treatment, the most useful appeared to be low concentrations of all 3 preparations acting over a long period of time. As a result of a long series of experiments, the authors recommend the carrying out of remedial baths directly in the ponds before the fish begin to winter, in concentrations of 0.0002% (1:500,000) for 4 days, or 0.00013% (1:750,000) for 5 days. This bath was given to 64,975 carp and 46,200 tench which were severely attacked by leeches. The results of the treatment were 100% successful, despite the low temperature of the water in the ponds (0-6°), and the fish underwent the treatment in very good health. (Authors)

9838. Rivas, L.R. (Univ. Miami, Coral Gables, Fla.). 1966. REVIEW OF THE Lutjanus campechanus COMPLEX OF RED SNAPPERS. Quart. J. Fla. Acad. Sci., 29(2): 117-136; Biological Abstracts, 48(18): Abst. No. 93705. 1967.

Two red snappers, Lutjanus campechanus and L. purpureus, and the silk snapper, L. vivanus, form a complex of closely related spp. Type specimens are described and the synonyms set forth. The specific name aya Bloch is shown not to apply, and the also widely used name blackfordi Goode and Bean is shown to be a synonym of campechanus. The name campechanus is shown to apply to the Gulf of Mexico not the Caribbean Sea red snapper for which the name purpureus is available. (Auth.)

9839. Villwock, Wolfgang (Zool. Staatsinst. und Mus., Hamburg, West Ger.). 1966. ISOLATION MECHANISM AND FORMATION OF SPECIES AMONG FISH WITH SPECIAL REGARD TO GEOGRAPHICAL ISOLATION FACTORS. Zool. Anz. 177(1): 84-110; Biological Abstracts, 48(18): Abst. No. 93710. 1967.

The many factors which contribute to the formation of sp. in fish are reviewed. It is necessary to distinguish between actual or potential sympatric isolating mechanisms which prevent the inbreeding of populations and allopatric speciation where geographical separation of a part of an original propagating community leads to a differentiation of isolate individual groups and thus to a possible formation of a sp. The various possibilities of sexual isolation within the framework of sympatric speciation are exemplified in the 50-75 million-year-long existence of Lake Baikal on Cottidae and their development into an endemic family, the Comephoridae and into 2 endemic subfamilies, and Cottocomephorinae and Abyssocottinae and on

other examples. Results of the geographic separation of the Anatolic carp, Tribus aphaniini are investigated and conclusions based on experimental findings which can be drawn with respect to the present day limits of propagating communities are discussed. --R. Kroha.

9840. Gooch, Burwell C. (Auburn Univ., Auburn, Ala.). 1967. APPRAISAL OF NORTH AMERICAN FISH CULTURE FERTILIZATION STUDIES. In: Proc. of the World Symposium on warm-water pond fish culture, Rome, Italy, 18-25 May 1966. FAO Fisheries Report No. 44, Vol. 3. pp. 13-26.

North American contributions to the aquatic fertilization literature are reviewed briefly. Although the results of these contributions make it relatively safe to predict that fertilization, either with inorganics or organics, will lead to an increase in aquatic productivity of one kind or another, little progress has been made beyond this primitive predictive stage. In particular, only three attempts have been made to monitor the fertilizer substances after they were added to the pond, and then to correlate fish production with the levels of the substances monitored. The inconsistent results obtained in these three studies, and the meager knowledge now extant about fertilizer dynamics in aquatic systems indicate that a major revision is needed in the approach to pond fertilization problems. Two fundamental aspects of any valid approach are discussed. (Auth.)

9841. Ouellette, R. P., and S. U. Qadri. 1968. THE DISCRIMINATORY POWER OF TAXONOMIC CHARACTERISTICS IN SEPARATING SALMONOID FISHES. Systematic Zoology, 17(1): 70-75.

The Fisher multiple discriminant function analysis is used to establish the ten most important morphological characteristics, from a list of forty-three measurements, that best separate the species Salvelinus namaycush, S. alpinus, S. fontinalis, S. malma, and Salmo gairdneri of the family Salmonidae. (Authors)

9842. Dobie, John (Div. of Game and Fish, Minnesota Dept. of Conservation, St. Paul, Minn.). 1967. EXPERIMENTS IN THE FERTILIZATION OF MINNESOTA FISH REARING PONDS. In: Proc. of the World Symposium on warm-water pond fish culture, Rome, Italy, 18-25 May 1966. FAO Fisheries Report No. 44, Vol 3. pp. 274-284.

Walleye (Stizostedion vitreum) ponds in Minnesota are fertilized each winter with organic fertilizers. In spring they are filled with water and stocked with walleye fry from nearby hatcheries. Fingerlings are harvested in July and August. Present fertilization methods are often inadequate and, consequently, the supply of plankters and insects for consumption by the fingerlings is not adequate, and fish must be harvested at a smaller size than is desirable to prevent large losses of fish from cannibalism. In 1957, ten one-acre drainable ponds were built at Waterville, Minnesota for a study of fertilization methods that could be used in Minnesota waters. Both organic and inorganic fertilizers have been tested separately and in various combinations. Pond conditions were studied in detail at weekly intervals. The studies have shown that most fertilizers produce extremely large populations of zooplankters in May and June, when the demand for food by the small fish is very low, while in July and August when the fish demand large quantities of food, zooplankton populations are very small. Most of these fertilizers have no measurable effect on the production of bottom fauna in a season of the year when the fish need these food organisms. Most fertilizers contain phosphorus that is readily liberated into the pond waters; this produces dense mats of filamentous algae or thick growths submerged aquatic vegetation. The best fertilization practice tried in the first six years of the project was a combination of dried sheep manure applied in one dose in April and weekly applications of a yeasty poultry food from mid-June to mid-August. The production of zooplankters and bottom fauna was better throughout the season than with any other fertilization practice studied.

9843. Shell, E.W. (Auburn Univ. Agric. Exp. Sta., Auburn, Ala.). 1967. FEEDS AND FEEDING OF WARM-WATER FISH IN NORTH AMERICA. In: Proc. of the World Symposium on warm-water pond fish culture, Rome, Italy, 18-25 May 1966. FAO Fisheries Report No. 44, Vol. 3. pp. 310-325.

Research on the nutrition of warm-water fish in North America is still in its infancy. The first controlled experiments were not conducted until the early 1950s. Currently there are four research stations in the United States actively engaged in research on the nutrition of warm-water fish: The agricultural Experiment Station, Auburn University, Auburn, Alabama; the Southeastern Fish Cultural Laboratory, U.S. Fish and Wildlife Service, Marion, Alabama; the Fish Farming Experimental Station, U.S. Fish and Wildlife Service, Stuttgart, Arkansas; and Kansas State University, Manhattan, Kansas. Almost all of the research work on the nutrition of warm-water fish has been concerned with the channel catfish (Ictalurus punctatus). Using this species, research has been carried out on nutrient requirements (protein, carbohydrate, fat, vitamins, calories and bulk); formulation of practical diets and factors affecting the feeding of this species. The review also includes information on the nutrition of other species where appropriate. (Auth.)

9844. Swingle, H.S. (Auburn Univ. Agric. Exp. Sta., Auburn, Ala.). 1967. ESTIMATION OF STANDING CROPS AND RATES OF FEEDING FISH IN PONDS. In: Proc. of the World Symposium on warm-water pond fish culture, Rome, Italy, 18-25 May 1966. FAO Fisheries Report No. 44, Vol. 3. pp. 416-423.

Rate of daily feeding is calculated either as a percentage of the total weight of the standing crop or on the basis of the daily increase in total weight of the standing crop. Both methods are subject to two sources of error. The first is the possible error in estimating the average weight of the population and the second is the error in estimating the number of individuals in a population at any one time, on the basis of seining samples. Estimates of standing crops may be made from the total amount of daily feed added up to any one point from the equation:

$$W = IR^N, \text{ where}$$

I = initial weight of fish,
R= the rate of change in weight during interval T, and
N= number of intervals "T" at which the daily feeding is readjusted.

For estimation of the rate of change in weight "R", it is necessary to know the pond conversion value "S" for the feed used at the rate it is being fed:

$$R_T = \frac{1 + DP}{S}, \text{ where}$$

D = number of days feed is added during interval T,
T = intervals at which feeding rate is readjusted,
P = daily feeding rates from 0.02 to 0.05, (2 percent to 5 percent of body weight),
S = pond conversion value at P and T for a particular feed and for a particular species of fish.

9845. Lebedeva, G.D. 1966. EFFECT OF VARYING SALT COMPOSITION OF WATER ON THE ACCUMULATION AND ELIMINATION OF CESIUM-137 IN A FRESH-WATER FISH. Radiobiologiya, 6(4): 556-559. Illus.; Biological Abstracts, 48(19): Abst. No. 94083. 1967.

When there is a specific activity of water of 1.10^{-7} curies/l, threshold accumulation of Cs^{137} occurs in the muscle tissue of fresh-water fish (year-old carp (Cyprinus carpio)) for 1-2 months and in bone tissue for 2.5-3 months. Cs^{137} intake in fresh-water fish can be reduced from 2-7 times by adding K and Na to the water. The biological and effective period for the semi-elimination of Cs^{137} in year-old carp is 6 days for muscle tissue and 15 days for bone tissue. (Auth. summ. transl.)

9846. Beridze, I.O., and R.I. Chkhaidze. 1964. SOME ASPECTS OF THE ACCLIMATIZATION OF HERBIVOROUS FISHES IN GEORGIA (USSR). Tr Nauch-Issled Rybokhoz Sta Gruzii 9. 30-37. (Georgian summ.). From: Ref. Zh., Biol., 1966, No. 3I175. (Translation); Biological Abstracts, 48(19): Abst. No. 94337. 1967.

Herbivorous fishes were raised in Potiisk waters and in 2 ponds of the Dzhapansk fishery collective since 1962. The stocking density in the ponds was 53 specimens/ha and 273 specimens/ha, respectively. Observations carried out in 1963 showed that under the conditions of a warm winter the grass carp has retained partial exogeneous feeding at a water temperature of 5 degrees C, and that a change-over to active feeding occurred in April at 7-8 degrees. The grass carp manifested a special preference for terrestrial plants: leaves of yellow alfalfa and of white and red clover; among water weeds it was partial to water chesnuts, floating pondweed and hornwort. The most intensive utilization of food was observed in August and September at a water temperature of 26.6-24.4 degrees C. In the first year of life, grass carp exhibited considerable differentiation of growth. From observations on the second year's growth of grass carp, it was established that individuals with an initial weight of 120-130 g attained a weight of 530 g in 3 months, while individuals with an initial weight of 200-300 g attained a weight of 850-900 g. During this period, larger individuals 500 to 700 g grew to a weight of 1,000 to 1,800 g. The yield of herbivorous carps was 128 kg/ha. In Potiisk waters, where the temperature was 4-6 degrees lower than on the collective farm, the average weight of grass carp was almost 400 g lower. It is recommended that the ponds be stocked only after they have become overgrown with macrophytes. In order to raise dockweed suitable for feeding the fishes, the ponds should be fertilized with decomposed manure. Fertilizers are applied to the pond at the rate of 20-40 kg/0.1 ha/day. In an area of this size the daily production of dockweed would amount to 150-300 kg.

9847. Faleeva, T.I. 1965. FUNCTIONAL BASES OF SPAWNING BEHAVOIR AND CARE OF THE YOUNG IN FISHES. In: Biological significance and functional determination of animal migratory behavior. Nauka: Moscow-Leningrad. 60-66. From: Ref. Zh., Biol., 1966, No. 6I137. (Translation); Biological Abstracts, 48(19): Abst. No. 94349. 1967.

The relationship between the developmental stages of spawning behavior and the final phases of oogenesis is examined. In Macropodus (fam. Anabanthidae) the first stage of oocyte formation--fusion of fat droplets and migration of the nucleus toward the edge of the fat droplet, is observed during the period of prespawning activity. The second stage--transition of the nucleus to fissions of maturation and ovulation occurs during the recurrence of spawning movements. Experiments have shown that the presence of males and females of Macropodus in the same aquarium is essential for the passage of the first phase of oocyte maturation, and that direct contact between males and females is required for the completion of maturation and ovulation. In Hemichromis (fam. Cichlidae) maturation of oocytes also occurs during the recurrence of spawning movements, but contact between males and females is not needed for the maturation and spawning of this species. The role of vision appears to vary at different phases of the spawning behavior, and also among species with a different ecology of spawning. Maturation of oocytes in isolated Macropodus females after hypophyseal injection stimulates nest construction, egg-laying and care of spawn. The experiment shows the correlation between external and internal factors in the development of spawning behavior.

9848. Galkina, Z.I. 1966. RELATIONSHIP BETWEEN THE QUALITY OF FEMALE RAINBOW TROUT AND THE QUALITY OF THEIR SPAWN. In: Report summaries of the All-Union Conference on the Ecology and Physiology of Fishes, 1966. Moscow. 83-84. From: Ref. Zh., Biol., 1967, No. 2I185. (Translation); Biological Abstracts, 48(19): Abst. No. 94351. 1967.

Data on weight, length and respiratory rate of female trout were compared with the survival rate and average weight of their spawn. A total of 86 females

were examined. A direct relationship has been established between their lengths and the average weight of their spawn. Eggs obtained from females with a high respiratory rate had the lowest death rate.

9849. Gerbil'skii, N. L. 1965. BIOLOGICAL SIGNIFICANCE AND FUNCTIONAL DETERMINATION OF FISH MIGRATION BEHAVIOR. In: Biological significance and functional determination of animal migratory behavior. Nauka: Moscow-Leningrad. 23-31. From: Ref. Zh., Biol., 1966, No. 6I135. (Translation); Biological Abstracts, 48(19): Abst. No. 94353. 1967.

Fish migration is regarded as an element in the system of species adaptations which constitute the basis for the biological progress of the species. Migration is of great importance in the development of a species; it facilitates range extension and development of intraspecific and intrapopulational biologic differentiation. Migrational behavior becomes modified during ontogenesis, a circumstance which is associated with increased adaptability to environmental conditions. Four stages of development of hereditary mechanisms are distinguished, which determine the capacity for adaptation from the cellular level of adaptive plasticity during the initial stages of ontogenesis to the attainment of maximum adaptability on the basis of the development of definite correlates. The system of correlates which determines the more complex forms of migration behavior were investigated most extensively in salmons. It includes the functions of the nervous system, of the hypothalomo-hypophyseal complex, of the thyroid gland, of the interrenal tissue and the osmoregulatory system. Functional mechanisms that determine migrational behavior are common to representatives of genetically distinct fish groups and are, at the same time, extremely variable within the limits of a species.

9850. Kol'gaev, A. M., and A. A. Zhirnova (Amur Br. Pacific Res. Inst. Fish. Oceanogr., Khabarovsk, USSR). 1966. EFFECT OF THE CONDITIONS OF DEVELOPMENT ON THE FAT METABOLISM OF EMBRYOS AND LARVAE OF THE AMUR AUTUMN CHUM (Oncorhynchus keta infraspecies autumnalis Berg.) Vop Ikhtiol, 6(2): 401-405. Illus.; Biological Abstracts, 48(19): Abst. No. 94365. 1967.

The report gives the results of histological and histochemical studies of the liver of the embryos and larvae of the Amur autumn chum (keta) at different stages of development and under different conditions of incubation and maintenance. Half of the (16,000) eggs were incubated and the larvae raised on pebbles; the second group was incubated and kept on hatchery frames with sand bottoms. Analysis of the fat content of the liver of both groups and the mortality rates indicated that fat dystrophy occurs in the liver of larvae raised in conditions similar to those for the second group. Therefore, it is advisable that hatching and raising salmon larvae in fisheries on sandy-bottomed frames under crowded conditions be discontinued and that these processes be done on gravel with adequate water circulation. --A. M. Hegland.

9851. Leonenko, E. P. 1966. HEMOGLOBIN LEVEL AS AN INDEX OF FISH VIABILITY AND PRODUCTIVITY (WITH SPECIAL REFERENCE TO CARP, GRASS CARP AND SILVER CARP). In: Report Summaries of the All-Union Conference on the Ecology and Physiology of Fishes, 1966. Moscow. 100-101. From: Ref. Zh., Biol., 1967, No. 2I131. (Translation); Biological Abstracts, 48(19): Abst. No. 94371. 1967.

Hemoglobin (Hb) concentration in the blood was found to be 5.8-10.6 g percent in carp, 7.8-10.8 g percent in grass carp and 9.4-12.1 g percent in silver carp: blood comprised 2.53-4.49 percent of the body weight in carp, 2.6-4.68 percent in grass carp and 2.7-4.57 percent in silver carp. Hb concentration was 1.65-3.3 g/kg body weight in carp, 2.0-3.44 in grass carp and 2.12-2.56 in silver carp. In carp the Hb concentration rose from 7.84 to 10.2 g percent during the winter.

9852. Phillippy, C. L. (Game and Fresh Water Fish Comm., Lakeland, Fla.). 1967. RESULTS OF SELECTIVE SHAD TREATMENTS IN SIX CENTRAL FLORIDA LAKES. Proc. 18th Ann. Conf. stheast. Ass. Game Commrs., 198-212.

The use of rotenone in an attempt to reduce the number of gizzard and threadfin shad in several Central Florida lakes has been intensified during the past two years. Descriptions and procedures employed in selective shad treatments of Lake Tarpon, Lake Seminole, Lake Tsala Apopka, Alligator Lake, Lake Julianna and Scott Lake are discussed in detail. Creel census data was not available, therefore, fish population samples collected over a two year period were compared to determine if a change has occurred in the species composition of the treated water areas. (Auth.)

9853. Hoffarth, Ray, and John Conder (Game and Fish Comm., Nashville, Tenn.). 1967. EXPERIMENTAL USE OF THE HAUL SEINE FOR ROUGH FISH REMOVAL IN FOUR TENNESSEE IMPOUNDMENTS. Proc. 18th Ann. Conf. stheast. Ass. Game Commrs., 213-230.

Four Tennessee impoundments, namely; Melton Hill Reservoir on the Clinch River, Watts Bar and Chickamauga reservoirs on the Tennessee River, and Douglas Lake on the French Broad River, were experimentally fished with an 1,800 yard haul seine from September 17 through December 11, 1963. Objectives of the experiment are as follows: to determine the effect of the haul seine in taking valuable market fish and other non-game fish; to determine its effect on game fish as to mortality and catchability, and to explore its possibilities as a sampling method for reservoir fish populations. A crew of seven men operated the gear and a fisheries biologist was present during the operation. The haul seine yielded 154,226 pounds of rough fish and 9,991 game fish by number, during the three months of the operation, which consisted of 54 days of actual fishing and 53 separate hauls. Four hundred and thirty-one (431) hours of operation or 3,017 man-hours were employed in this winter phase of the experiment. The original investment was valued at $14,960. Returns netted approximately $1,868 per month (based on wholesale prices per pound of fish) at an operational cost of about $4,160 per month, leaving a monthly deficit of $2,292. The average catch per 1,000 yards of seine netted approximately 1,617 pounds of rough fish and 105 game fish by number. The average haul yielded 2,909 pounds of rough fish and 188 game fish by number. Harvest was greatest when the reservoir was stable or rising, and decreased when the reservoir was dropping. Stomach analysis revealed that catfish, large drum, and redear sunfish were utilizing the Asiatic clam, Corbicula fluminea, a recent arrival in Tennessee waters. Results of the haul seine experiment demonstrated that this gear could be used accurately to sample shoreline fish populations and to locate winter concentrations of certain game fish as well as rough fish. One 400-yard haul on Douglas Reservoir yielded 382 game fish weighing approximately 423 pounds and 100 pounds of rough fish. Finding concentrations of marketable rough fish in locations suitable for seining and a market for gizzard shad and other potential commercial fish such as small drum, are the main factors affecting the commercial success of the haul seine. (Authors)

9854. Bayless, Jack, and William B. Smith (Div. of Inland Fisheries, North Carolina Wildlife Resources Comm., Raleigh, N. C.). 1967. THE EFFECTS OF CHANNELIZATION UPON THE FISH POPULATIONS OF LOTIC WATERS IN EASTERN NORTH CAROLINA. Proc. 18th Ann. Conf. stheast. Ass. Game Commrs., 230-239.

This paper concerns an evaluation of the effects of habitat alteration associated with stream channelization in eastern North Carolina. The evaluation was based upon a comparison of fish populations found in 23 channeled streams, and 36 proximate natural streams within the Chowan, Neuse, Northeast Cape Fear, Pamlico, Perquimans, and Tar River Watersheds. These comparisons indicated that reductions in the magnitude of 90 percent occurred both in weight of game fish per acre, and in number of game fish exceeding six inches total length per acre, following channelization. The data further revealed that no significant return towards the natural stream populations occurred within a 40-year period following channelization. (Authors)

9855. Wegener, William L., and James P. Clugston (Fisheries Experiment Station, Leesburg, Fla.). 1967. FLORIDA'S STATE-WIDE TAGGING PROGRAM. Proc. 18th Ann. Conf. stheast. Ass. Game Commrs., 239-247.

The Florida Game and Fresh Water Fish Commission has conducted a state-wide fish tagging program for the years 1961 through 1964. Rewards from $25.00 to $10,000.00, offered by the Joseph Schlitz Brewing Company, insured a high return to the Commission of those fish caught by the anglers. During the four year period, 28,805 fresh-water fish were tagged and released in 120 lakes, rivers, and canals throughout the state. Ten species of fish were tagged with the largemouth bass providing the highest returns (27.9 percent of the 9,079 bass tagged were returned). The recaptures for six other centrarchids were considerably lower, ranging from 4.3 percent for the bluegill (11,658 tagged) to 13.8 percent for the redbreast sunfish (370 tagged). Tilapia nilotica, tagged in a number of Fish Management Areas, provided a return of 15.0 percent (349 tagged). The grand total returned for all species was 12.5 percent. The largemouth bass was the only species which was returned in any significant number during the second and third year after tagging. The weighted estimate of survival rates for the largemouth bass were: 1961, 14.2 percent; 1962, 16.2 percent; and 1963, 14.8 percent. The mean rates of exploitation for the largemouth bass were: 1961, 21.2 percent; 1962, 25.7 percent; and 1963, 27.7 percent. Since the period from tagging until recapture was quite short for most species, little growth information was obtained. (Authors)

9856. Taylor, Clovis O., and Billy B. Carroll (Tennessee Valley Authority, Wilson Dam, Ala.). 1967. METHODS AND TECHNIQUES NORRIS RESERVOIR SPORT FISHING SURVEY, 1963. Proc. 18th Ann. Conf. stheast. Ass. Game Commrs., 247-255.

Creel census information available for TVA reservoirs consisted largely of samples of the catch during the peak spring fishing period. Estimates of total fishing pressure were scarce and economic data nonexistent. To obtain such information, TVA and the Tennessee Game and Fish Commission conducted a one-year sport fishing survey of Norris Reservoir. This report describes census design and methods developed with the assistance of the Institute of Statistics at North Carolina State University. The reservoir was divided into three major areas. Expanded estimates of boat and bank fisherman use, catch, and expenditures in each area were completed biweekly. Total hours of pressure and numbers of fishermen were determined from aerial counts and boat rental records from selected boat docks. Harvest information was collected by creel clerks Saturday, Sunday, Wednesday, and two other week days selected randomly. Economic data were obtained from 10 percent of the fishermen contacted. (Authors)

9857. Finucane, John H., and Gordon R. Rinckey (Bur. of Commercial Fisheries Biological Station, St. Petersburg Beach, Fla.). 1967. A STUDY OF THE AFRICAN CICHLID, Tilapia heudeloti Dumeril, IN TAMPA BAY, FLORIDA. Proc. 18th Ann. Conf. stheast. Ass. Game Commrs., 259-269.

Ecological observations of the African cichlid, Tilapia heudeloti, are reported from the Tampa Bay estuarine system. Hydrological and biological data were compiled during 1963 and 1964. Specimens as large as 237 mm (standard length) and weighing 487 grams were caught. Breeding appeared to begin in April or May and continue until December. Spawning occurred in brackish waters with an average salinity of 13.06%. In the study area, T. heudeloti was tolerant of water temperatures as low as 49.3° F (9.6° C) and as high as 89.6° F (32° C). Its food consisted of bottom detritus and phytoplankton. Attempts to catch tilapia in Tampa Bay with artificial or live bait were not successful. Economically, T. heudeloti offers some promise of becoming a commercially important estuarine species in Florida waters. (Authors)

9858. Bowling, Michael L., and Raymond L. Busbee (Game and Fish Comm., Atlanta, Ga.). 1967. A THREE-YEAR STUDY ON THE EFFECTS OF LIME APPLICATIONS ON THE STANDING CROP OF BENTHIC ORGANISMS IN GEORGIA FARM PONDS. Proc. 18th Ann. Conf. stheast. Ass. Game Commrs., 280-302.

Six Georgia farm ponds, three on sandy soils and three on clay soils, were observed during a 32-month study period to determine the quantitative production of benthic organisms in relation to applications of agricultural lime. Three of the ponds were treated with lime at the rate of one ton per acre. The remaining three ponds were maintained as controls. Water total hardness in the experimental ponds increased significantly during the first year after treatment and began to drop during the third year, although it remained at a level higher than that observed before treatment. The bottom soil calcium oxide content began to increase during the third year after treatment. The quantity of benthos in the experimental ponds began to increase after treatment and remained at a higher level during the entire study period while that of the control ponds remained relatively constant or decreased. (Authors)

9859. Swingle, H.S. (Auburn Univ., Agric. Experiment Station, Auburn, Ala.). 1967. EXPERIMENTS WITH THE FLATHEAD CATFISH ("Pylodictis olivaris") IN PONDS. Proc. 18th Ann. Conf. stheast. Ass. Game Commrs., 303-308.

Experiments conducted from 1938 to 1941 indicated that large flathead catfish were predatory and in several cases eliminated the larger bluegills. In the 1962 experiments, 2- to 5-inch flatheads eliminated almost all the fathead minnows, while the larger flatheads (10 inches) stocked in 1963 experiments apparently fed on larger bluegills in preference to fatheads. They eliminated all the large bluegills they could swallow except for a few in the 7-inch group and had left very few in the 4- to 6-inch groups. This apparently indicated a preference for larger fish as the flatheads increased in size, and suggests that the large flathead may compete with fishermen for fish of harvestable size. These experiments indicate that flathead catfish of all sizes should be listed as a "C" (piscivorous) species in population analysis. The smallest fish would eat any other small enough to be swallowed. Where they could not swallow another of their own species, they often severely wounded them by biting. (Auth.)

9860. Stubbs, John M. (Game and Fish Comm., Nashville, Tenn.). 1967. A DYNAMITE SAMPLING STUDY ON THE HIWASSEE AND OCOEE RIVERS IN EAST TENNESSEE. Proc. 18th Ann. Conf. stheast. Ass. Game Commrs., 325-335.

In the winter of 1960 and 1961 the Tennessee Game and Fish Commission received reports that fish kills had occurred on the Hiwassee River. During the month of March 1961 a study was developed on the Hiwassee and Ocoee Rivers to determine the fish population and to locate as accurately as possible the area or areas of adverse conditions relative to fish survival. Six stations were selected in cooperation with the Tennessee Stream Pollution Control Board. Due to the large volume of water the percusion method was employed as a sampling technique. At two of the six stations carp were tethered to try to determine the effect of the explosive on fish. While this report is primarily concerned with the fish population, attention is given to the use of dynamite as a sampling technique in the hope that it may be of aid in future studies of this type. (Auth.)

9861. Howell, Henry H. (Asbury College, Wilmore, Ky.). 1967. THE RESULTS OF A FIVE-YEAR FISH MANAGEMENT EXPERIMENT IN A SMALL LIMESTONE QUARRY IN KENTUCKY. Proc. 18th Ann. Conf. stheast. Ass. Game Commrs., 336-341.

Small limestone quarries may be found in many parts of the nation. In the Blue Grass Region of Kentucky these quarries frequently fill with water when abandoned. An effort was made to manage one such one-fourth acre pond for fishing. The pond was poisoned in 1958, and then stocked with largemouth bass and bluegill bream the spring of 1959. For the next five growing seasons a heavy plankton bloom was maintained with commercial fertilizer. Hook and line fishing began in the spring of 1960 and continued through four growing seasons. For the

first three years the bluegill fishing was excellent, the catch in pounds being 128, 121, and 75 respectively. This would be equivalent to catches of 300 to 500 pounds per acre. The bluegill catch dropped to 28 pounds the last year because of imbalance. Too many largemouth had been removed the year before. The largemouth grew rather slowly, and no fish weighing more than 1 pound was caught until the last year. Not only was imbalance indicated by poor fishing the last year, but also by plankton and bottom organism composition. (Auth.)

9862. Conder, John R. (Game and Fish Comm., Nashville, Tenn.). 1967. STANDING TIMBER IN BARKLEY RESERVOIR. Proc. 18th Ann. Conf. stheast. Ass. Game Commrs., 430-433.

Two hundred and ten trees were topped and left standing as markers to locate channels and slough areas in four sections of Barkley Reservoir in Tennessee. These trees will extend above the surface of the water when the lake is at normal pool elevation and are spaced so that fishermen will be able to readily locate these creeks and sloughs which are thought to be the most desirable fishing areas. The creeks and sloughs which were marked and the number of trees left standing on each are as follows: Shelby Creek, 16; Bear Creek, 120; Barrett Creek, 49; and Big Slough, 25. The total cost of this project was $2,224.00, and the average cost per tree was $10.59. (Auth.)

9863. Snow, J.R. (Bur. of Sport Fisheries and Wildlife, Marion, Ala.). 1967. SIMAZINE AS A PREFLOODING TREATMENT FOR WEED CONTROL IN HATCHERY PONDS. Proc. 18th Ann. Conf. stheast. Ass. Game Commrs., 441-447.

The result of applying preflooding applications of simazine to warm-water hatchery ponds employed in the culture of largemouth bass, bluegill and channel catfish fingerlings is described. Rates of 10 and 15 pounds active simazine per acre appeared to reduce the incidence of algal growths such as Pithophora and Hydrodictyon and inhibited development of submerged rooted weeds. Effects generally persisted for one production period but were not noticeable in succeeding production cycles. Some indication was obtained that phytoplankton development was retarded but fish production was not appreciably lower in treated ponds than that in untreated ones. The development of zooplankton did not appear to be retarded by simazine applications to bass rearing ponds. Some advantages of preflooding treatment of warm-water hatchery ponds are discussed. (Auth.)

9864. Pierce, Phillip C., John E. Frey, and Henry M. Yawn (Georgia Game and Fish Comm., 401 State Capitol, Atlanta, Ga.). 1967. FIELD EVALUATIONS OF NEWER AQUATIC HERBICIDES. Proc. 18th Ann. Conf. stheast. Ass. Game Commrs., 448-474.

9865. Sills, Joe B. (Bur. of Sport Fisheries and Wildlife, Fish Farming Exper. Station, Stuttgart, Ark.). 1967. A REPORT ON THE USE OF KARMEX TO CONTROL FILAMENTOUS ALGAE IN FISH PONDS. Proc. 18th Ann. Conf. stheast. Ass. Game Commrs., 474-479.

Several chemicals that have been used in fish culture for the control of filamentous algae are discussed. Their effects on fish and fish-food organisms in ponds are reviewed. Results obtained from applications of Karmex to 26 ponds are presented. Data show that Karmax was effective against several forms of filamentous algae at rates above one-half pound per surface acre. Rates up to three pounds per surface acre had no adverse effects on fish or fish-food organisms. (Auth.)

9866. Hughes, Janice S., and James T. Davis. 1967. EFFECTS OF SELECTED HERBICIDES ON BLUEGILL SUNFISH. Proc. 18th Ann. Conf. stheast. Ass. Game Commrs., 480-482.

The toxicity to bluegill sunfish (Lepomis macrochirus Rafinesque) of 15 new or reformulated herbicides is presented. Six phenoxy compounds assayed were within toxicity limits previously reported. The endothal derivatives tested were

also within previous limits but did show promise as an aquatic herbicide. Substituted urea compounds checked did not demonstrate any differences from those previously reported. A pelletized formulation of sodium arsenite was very toxic but should be more convenient to apply. (Authors)

9867. Lantz, Kenneth E., James T. Davis, Janice S. Hughes and Harry E. Schafer, Jr. 1967. WATER LEVEL FLUCTUATION—ITS EFFECTS ON VEGETATION CONTROL AND FISH POPULATION MANAGEMENT. Proc. 18th Ann. Conf. stheast. Ass. Game Commrs., 483-494.

The fluctuation of water level as a lake management practice in Louisiana is explained using three lakes as examples. These lakes vary from 1,000 to 2,600 acres and are scattered over the state. Anacoco Lake, a 2,600 acre impoundment in central Louisiana, was fluctuated primarily for aquatic vegetation control. The vegetation was reduced 90% over a period of three years. The effects on the fish population as shown in annual rotenone samples were an intermediate size sunfish. Fishing success improved markedly. Bussey Lake, an impoundment of 2,200 acres in northeastern Louisiana, was extensively studied. Fluctuation data is presented showing that noxious vegetation was reduced over 95% in two years. The effects on both the fish population and fishing success were extremely favorable with harvest per acre up over 250%. Lafourche Lake, a 1,000 acre cutoff stream channel in northeastern Louisiana was fluctuated three years for vegetation control. Success on aquatic vegetation control was good. A discussion of the effects on the fish population is presented. The most important aspects in planning a water level fluctuation program are discussed with particular emphasis on degree and timing. (Authors)

9868. Davis, James T., and Janice S. Hughes. 1967. RESULTS OF CREEL CENSUS ON FOUR NORTH LOUISIANA LAKES. Proc. 18th Ann. Conf. stheast. Ass. Game Commrs., 495-506.

Four lakes representing widely different types but of generally comparable size are compared from the standpoint of sustained angler harvest. The range in size is from 1,000 acres to 2,200 acres, in age from 5 years to 30 years, and from an artificial impoundment to a cut off stream channel. All four lakes are dependent to a large extent on the metropolitan area of Monroe, Louisiana for their fishing public. The catch rate varied from 0.4 pounds per hour on Bayou DeSiard to 1.2 pounds per hour on Bussey Lake. The yield varied from a high of 215 pounds per acre on Bussey Lake to a low of 14 pounds per acre on Lafourche Lake. A general description of the four lakes is presented including comments as to the adequacy of the boat rental facilities and access points. The impact of these factors on the harvest is discussed. Heavy fishing pressure on the lakes under study did not cause a marked reduction in the catch per hour. Rotenone samples indicate little change in the standing crop during the period of the study. It is concluded that these lakes could all withstand much heavier fishing pressure and still yield acceptable catch rates. (Authors)

9869. Giudice, John J. 1967. THE PRODUCTION AND COMPARATIVE GROWTH OF THREE BUFFALO HYBRIDS. Proc. 18th Ann. Conf. stheast. Ass. Game Commrs., 512-517.

Hybrids were produced by crossing the black, smallmouth, and bigmouth buffalo fishes. Growth-rate data for a two-year period are presented. The black x bigmouth individuals showed a pronounced acceleration of growth over that of the other hybrids and their parent species. (Auth.)

9870. Stevens, Robert E. (South Carolina Wildlife Resources Dept., Moncks Corner, S. C.). 1967. A FINAL REPORT ON THE USE OF HORMONES TO OVULATE STRIPED BASS, Roccus saxatilis (Walbaum). Proc. 18th Ann. Conf. stheast. Ass. Game Commrs., 525-538.

During the 1964 striped bass spawning season, 383 female striped bass were treated with hormones at the Moncks Corner Striped Bass Hatchery and 337 (88%) were induced to ovulate as a result of the treatment. Three hundred and seventeen

of the successful females were spawned in the hatchery for a yield of 322 million eggs and a hatch of 100 million fry. Chorionic gonadotropin was the most successful hormone used. Approximately 60 million fry were stocked in the Wateree Reservoir, a 13,710 acre impoundment, and early seining results indicate a significant survival. (Auth.)

9871. Davis, James R., and Randall P. Cheek (North Carolina Wildlife Resources Comm., Raleigh, N.C.). 1967. DISTRIBUTION, FOOD HABITS, AND GROWTH OF YOUNG CLUPEIDS, CAPE FEAR RIVER SYSTEM, NORTH CAROLINA. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 250-260.

A total of 816 American shad (Alosa sapidissima), 2,823 blueback herring (A. aestivalis), and 79 alewives (A. pseudoharengus) was collected between July and November 1963-1965 to determine distribution, food habits, and growth in the Cape Fear River system, North Carolina. Shad and blueback herring were found in the Cape Fear River from four miles south of Wilmington (20 miles from the mouth) to Lock No. 3, a distance of 99 miles, and in the Black River from the mouth to NC-411 bridge, a distance of 35 miles. In the North East Cape Fear River, shad were distributed from the mouth to NC-24 bridge, a distance of 67 miles, whereas blueback herring were distributed from the river mouth to five miles north of NC-53 bridge, a distance of 44 miles. Alewives were collected in a seven-mile stretch of the Cape Fear River, from four miles south of Wilmington to three miles north of Wilmington and in the North East Cape Fear River from the mouth to Lanes Ferry, a distance of 25 miles. None were collected in Black River. The data showed American shad fed primarily on aquatic and terrestrial insects and crustaceans, and insects were the dominant food, whereas blueback herring and alewife fed chiefly on crustaceans. Only minor differences were found in the food habits of each species within or between rivers. The growth rates of individual species were similar between rivers. Seaward migration occurred from October to November and was in association with an increase in water level and a decrease in water temperature. (Authors)

9872. Laurence, Geoffrey C., and Ralph W. Yerger (Dept. of Biological Science, Florida State Univ., Tallahassee, Fla.). 1967. LIFE HISTORY STUDIES OF THE ALABAMA SHAD, Alosa alabamae, IN THE APALACHICOLA RIVER, FLORIDA. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 260-273.

Since information on the biology of the Alabama shad, Alosa alabamae, of the Gulf coast of the United States is almost nonexistent, a study was initiated in February 1966. Adult shad were collected on their spawning run in the Apalachicola River system, Florida, from February to April. Interpretation of the scale structure indicated that four age classes were represented. A few one-year-old males (average 10.6 inches TL) were in evidence in the latter part of the run. The two-year class consisted mostly of males (average 13.4 inches TL), and small numbers of females (average 14.5 inches TL). Three-year-old fish were most abundant; males (average 14.4 inches TL) and females (average 15.3 inches TL) were found in equal numbers. Small numbers of four-year-olds were taken; most were females (average 16.1 inches TL) and a few were males (average 15.1 inches TL). No specimens more than four years old were collected. Preliminary indications are that one-, two-, and three-year-old males, and two-, and three-year-old females may return to spawn the following year. The adult fish entered the river in mid or late February and attained peak numbers in late April. A gradual ripening of the gonads was observed until the water temperature reached 20° C in late April, at which time spawning took place abruptly. Egg counts in ovaries ranged from 40,000 to 150,000. Food habit studies based on stomach analyses reveal that the adults take little or no food, and that juveniles feed largely on small fishes and aquatic dipterans. Growth and movements of juveniles were followed from June to September. Two distinct size groups of juveniles collected from the lower reaches of the river indicate that spawning takes place in at least two different areas in the drainage system. (Authors)

9873. Elrod, Joseph H., and John R. Kelley, Jr. (Agricultural Experiment Station, Auburn Univ., Auburn, Ala.). 1967. COST ANALYSES OF SPORT FISHING IN COMMERCIAL CATFISH PONDS. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 273-278.

Fishermen were interviewed as they fished for catfish and largemouth bass in pond S-1 (22 acres) and pond S-7 (2.5 acres) of the Auburn University Fisheries Research Unit to determine selected expenditures per trip. From September 15 to December 5, 1965 and from March 16 to June 16, 1966, 13,528 people fished, of which 1,434 were interviewed. In addition to the $1.00 pond permit fee, fishermen spent $1.25 per trip for travel and $0.89 per trip for bait and equipment. Average round trip distance traveled per fisherman was 3.45 miles. The individual average expenditure per trip was not related to day of the week. Total expenditures were estimated to have been $42,628 for 150 days of fishing. Permit cost was $13,528; bait cost, $6,872; equipment, $5,297 and travel expense, $16,931. The gross expenditure was $1,740 per surface acre of water. (Authors)

9874. Claffey, Francis J., and Janet E. Ruck (State Univ. College at Brockport, Brockport, N.Y.). 1967. THE EFFECT OF ROTENONE ON CERTAIN FISH FOOD ORGANISMS. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 278-283.

While all four fish food organisms (damselfly nymphs, dragonfly nymphs, mayfly nymphs, and caddisfly larvae) were killed by various rotenone concentrations, dragonfly nymphs had the greatest resistance and caddisfly larvae the least. Concentrations of rotenone currently being used in fish eradication would not effect the populations of the test organisms except that a very slight reduction in the caddisfly larvae population might result from the higher concentrations that are sometimes used. No change in structure or deterioration of gills before and after rotenoning could be observed by microscopic examination. Survival of all four organisms was excellent under laboratory conditions. Oxygen deficiencies were not a factor in killing test organisms. Mayfly nymphs consumed the greatest amount of oxygen and damselfly nymphs the least. The damselfly nymphs could survive a low oxygen tension without their gills while the other test organisms could not. (Authors)

9875. Ware, Forrest J. (Florida Game and Fresh Water Fish Comm., Lakeland, Fla.). 1967. THE FOOD HABITS OF CHANNEL CATFISH IN SOUTH FLORIDA. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 283-287.

Since channel catfish, Ictalurus punctatus, were being considered as a possible predator for the control of forage fish in Florida lakes, a study of their food habits was conducted. An examination was made of the stomachs of 195 channel catfish collected in Lake Okeechobee, Lake Blue Cypress, and Lake Agnes, with trammel nets. The size range of fish examined was eight to 30 inches in total length. The major food items were insects, crustaceans, and fish. Data is presented according to the frequency of occurrence and number of food items contained in the stomachs. The lengths of channel catfish and the foods eaten are discussed. (Auth.)

9876. Applegate, Richard L., and James W. Mullan (Bur. of Sport Fisheries and Wildlife, Fayetteville, Ark.). 1967. FOOD OF THE BLACK BULLHEAD (Ictalurus melas) IN A NEW RESERVOIR. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 288-292.

Stomach contents of black bullheads (Ictalurus melas) collected from inshore areas of newly impounded Beaver Reservoir by electroshocker revealed distinct differences in diet between periods of relatively stable water levels and rapidly rising water level. During stable water level periods, Entomostraca formed 72 percent of the volume of food of young-of-the-year bullheads (<4 inches, total length). Filamentous algae, organic detritus and crayfish made up 94 percent of the food volume found in 4.0-11.3-inch bullheads collected during these periods. Contrastingly, during winter-spring months when water level rose and inundated basin soils for the first time, bullheads over four inches ate predominately terrestrial animals (56% by volume). Earthworms comprised 28 percent of the

total volume, followed by a wide representation of insects (15 percent), particularly grubs and caterpillars. Slugs, spiders, centipedes, millipedes, pill bugs and a worm snake were recorded. Filamentous algae remained an appreciable (26 percent) component of the food consumed. Black bullheads (4 to 8 inches in length) were collected in offshore areas at night by midwater trawl during the summer. Stomach contents were comprised almost entirely (98 percent) of the phantom midge, Chaoborus. (Authors)

9877. Carnes, W. Cape (Div. of Inland Fisheries, North Carolina Wildlife Resources Comm., Raleigh, N. C.). 1967. PRELIMINARY OBSERVATIONS ON SUPPLEMENTARY FEEDING OF POND FISHES. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 292-296.

The food cycle of bluegill and redbreast sunfish was short circuited by direct feeding of dry pellets in an attempt to increase the productivity of small lakes. Automatic fish feeders were constructed and installed in an experimental lake and were programmed to feed specific amounts of Purina Trout Chow at regular intervals. This paper deals with the construction of the automatic feeder and preliminary observations on the growth rate of bluegill and redbreast sunfish. (Auth.)

9878. Swingle, Hugh S. (Agricultural Experiment Station, Auburn Univ., Auburn, Ala.). 1967. TEMPERATURE TOLERANCE OF THE PEACOCK BASS AND A POND TEST OF ITS VALUE AS A PISCIVOROUS SPECIES. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 297-299.

Since the introduction of the peacock bass, Cichla sp., into Florida in 1964, several southeastern states have considered introducing it as a new piscivorous game species. Tests show that fingerling peacock bass die at temperatures below 61° F., and, therefore, they would be unsuitable for introduction outside of tropical areas unless overwintered indoors or in heated water. In one pond stocked with 108 peacock bass per acre, tilapia, and fathead minnows, the peacock bass appeared to be a less effective predator than the largemouth bass when stocked under similar conditions. However, growth rates were approximately the same for peacock bass and largemouth bass at the end of a six-month period. (Auth.)

9879. Pardue, Garland B., and F. Eugene Hester (Fisheries Building, Auburn Univ., Auburn, Ala.). 1967. VARIATION IN THE GROWTH RATE OF KNOWN-AGE LARGEMOUTH BASS (Micropterus salmoides Lacepede) UNDER EXPERIMENTAL CONDITIONS. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 300-310.

Experiments were conducted in three ponds and nine plastic swimming pools to determine the variation in growth rate of largemouth bass (Micropterus salmoides) during their first year of life. Known-age fish were obtained from artificially stripped and fertilized eggs and from the nest of one pair of largemouth bass. The fry were stocked into pools or ponds. Fathead minnows (Pimephales promelas) were stocked into three ponds and four large plastic pools as brood fish to provide offspring as forage for the bass which were added later. Golden shiners (Notemigonus crysoleucas) were stocked into the ponds after the bass were added. Fathead minnows, mosquito-fish (Gambusia affinis) and golden shiners were added at intervals in the small pools after the bass were approximately one inch long, and in the large pools to supplement the original stocking of fathead minnows. Samples of approximately 10 bass were taken periodically. The weight and total length of each fish was measured and the fish was returned. When the experiments were terminated, weight and total length were again taken and sex was determined when this could be done without sacrificing the fish. Seventy-one to 243 bass were stocked as fry or one-inch fingerlings into each pond or pool. Survival to approximately one year of age varied from 1.0 to 34.5 percent. Variation in growth rate within individual pools or ponds ranged from 1.9X (largest individual weighed 1.9 times as much as smallest individual in the population) to 20.3X. Coefficient of variability ranged from 14.2 to 94.0. Variation between individuals of a population was, in general, closely correlated with both population density and rate of growth.

Variation was greatest in those populations having the greater densities and the slower growing individuals. Differences in growth rate between the sexes could only be determined in the pond experiments as most bass in the pools did not reach sexual maturity during the study period. In all three pond populations, the males were larger than the females when the experiments were terminated. In Liles', Gay's, and Knott's ponds the males averaged 188.0, 163.0 and 363.6 grams, respectively, while the females averaged 162.1, 149.4 and 328.9 grams, respectively. Males attained sexual maturity at a smaller size than the females. (Authors)

9880. Buntz, Jon (Florida Game and Fresh Water Fish Comm., Lakeland, Fla.). 1967. STOMACH ANALYSIS OF CHAIN PICKEREL (Esox niger) OF SOUTH CENTRAL FLORIDA. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 315-318.

Alabama surveys indicate that the chain pickerel is undesirable because it preyed on harvestable species (1954, Annual Report Farm Ponds Project, Auburn University, unpublished). An examination of pickerel stomach contents was conducted in South Central Florida to explore possibilities of using pickerel as a desirable predator. Specimens were collected from anglers, trammel nets, and electro-shocking. One hundred fifteen adult pickerel collected from seven lakes, Pierce, Francis, June in Winter, Henry, Kissimmee, Hatchineha, and Walk'n Water, were examined. The data collected indicate the chain pickerel feed almost entirely on fish and quite heavily on centrarchids, such as bluegills. These data also show that although pickerel will consume harvestable game species, 79.55% of all organisms consumed were not harvestable game fish. Variety of prey, mode of species consumed,and length frequency of prey to predator are discussed. (Auth.)

9881. Shannon, Eugene H. (North Carolina Wildlife Resources Comm., Raleigh, N. C.). 1967. GEOGRAPHICAL DISTRIBUTION AND HABITAT REQUIREMENTS OF THE REDBREAST SUNFISH Lepomis auritus IN NORTH CAROLINA. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 319-323.

In order to determine the distribution and habitat requirements of the redbreast sunfish Lepomis auritus (Linnaeus) in the streams and reservoirs of North Carolina a more detailed analysis of the data were extrapolated from previous watershed and reservoir survey reports made by personnel of the Wildlife Resources Commission from 1956 to 1966. It was concluded from the study that: (1) Redbreast sunfish inhabit 23 of the 26 major watersheds within the State; (2) Redbreast sunfish inhabit (a) waters reaching elevations up to 3,500 feet, (b) waters having up to eight percent sea-water equivalency, and (c) a pH range between 4.8 and 8.4; and (3) The gamefish species most frequently associated with the redbreast sunfish in the Mountain, Piedmont, and Northeastern watersheds was the bluegill, whereas warmouth, redfin pickerel and/or largemouth bass were most frequently associated in the Southeastern Coastal watersheds. (Auth.)

9882. Smith, William B., William R. Bonner, and Buford L. Tatum (Div. of Inland Fisheries, North Carolina Wildlife Resources Comm., Raleigh, N. C.). 1967. PREMATURE EGG PROCUREMENT FROM STRIPED BASS. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 324-330.

Striped bass were successfully ovulated in Albemarle Sound, North Carolina, some 150 miles from their natural spawning grounds and about one month before their normal spawning time. Brood fish were purchased from commercial fishermen, consequently the eggs so obtained were salvaged out of a sacrificial situation. The fish were collected from pound nets following narcosis by electric shock; the narcosis being maintained by the addition of Quinaldine to the water in the boat holding tank until the female fish had been injected with human chorionic gonadotropin at the egg taking station. During egg maturation, the female striped bass were held individually in glass-fronted aquaria. Whenever a fish was transferred from one aquarium to another, or whenever egg samples needed to be taken, the fish normally were tranquilized by the addition of Quinaldine to the aquarium water before the fish were handled. A myriad of problems were encountered during this experimental operation but, as a whole, it was successful. Of 243 striped bass

brought to the egg taking station, 125 survived to ovulation and produced some 28,530,000 eggs. Two hybridization experiments were successful: One male white perch x female striped bass cross produced 80,000 fry, and one male white bass x female striped bass cross produced 200,000 fry. (Authors)

9883. McGill, Edward M., Jr. (Arkansas Game and Fish Comm., Lonoke, Ark.). 1967. POND WATER FOR REARING STRIPED BASS FRY, Roccus saxatilis (Walbaum), IN AQUARIA. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 331-340.

Fry striped bass, Roccus saxatilis (Walbaum), were hatched at the Weldon, North Carolina State Fish Hatchery from eggs obtained from hormone-injected females collected from commercial pound nets in Albemarle Sound, North Carolina. The fry were packaged when two and three days old in conventional square (15" x 15" x 22") plastic bags with an oxygen atmosphere and shipped to Arkansas by airplane in insulated containers. Two hundred thousand (200,000) fry were held in each of two 58-gallon aquaria at the Joe Hogan State Fish Hatchery, Lonoke, Arkansas, for six days. Frequently changed, filtered pond water was used. At the end of six days when the fry were eight and nine days old and were swimming horizontally and feeding, they were released into a seven and one-fourth (7.25)-acre nursery pond. Total mortality during the entire operation from the time the fry were packaged in the plastic bags in North Carolina until they were released in the nursery pond in Arkansas was estimated to have been less than seven percent. Upon draining the nursery pond sixty-three thousand six hundred seventeen (63,617) fingerlings were harvested (seventeen percent of total estimated fry stocked). These fingerlings were planted in Dardanelle Reservoir on the Arkansas River. (Auth.)

9884. Frey, John E., and Phillip C. Pierce. 1967. THE EFFECTS OF COLD WATER DISCHARGE ON A DOWNSTREAM RESERVOIR'S TEMPERATURE AND OXYGEN LEVELS. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 357-363.

Data are presented on the effects cold water discharge from Hartwell Dam has on a 20-mile stretch of river between Hartwell and Clark Hill Reservoirs and its influence on the temperature and oxygen concentrations beneath the thermocline in the lower lake. This study revealed that oxygen concentration increased from 0.7 ppm to between 3.2 and 6.7 ppm when the sub-60° F water was taken from a 105-foot depth in Hartwell Lake and discharged into the tailrace during generation periods. This water further increased its oxygen content as it became agitated while moving over shoal areas between the two reservoirs even though the water temperature sometimes reached 80° F for short periods of time when the river was low following generation shutdown. Monthly temperature and oxygen collections taken from eight stations between the headwater and dam of the 70,000-surface-acre Clark Hill Reservoir indicated that the entire lake was capable of supporting trout through the month of April. However, this area was reduced to approximately 25% of the total lake surface and 15% of its volume by mid-September. It was also learned that the cold oxygenated water was stratified between two cold low oxygen-bearing layers in the deeper areas nearest the dam and that the suitable trout water (temperatures below 70° F and containing at least 3.0 ppm oxygen) extended laterally at the same depth but did not contain sufficient oxygen in the larger bays and tributaries after July. (Authors)

9885. Kirkland, Leon and Michael Bowling (Georgia Game and Fish Commission, Atlanta, Ga.). 1967. PRELIMINARY OBSERVATIONS ON THE ESTABLISHMENT OF A RESERVOIR TROUT FISHERY. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 364-374.

A sport fishery for rainbow trout (Salmo gairdneri) and brown trout (Salmo trutta) was created in the lower one-third of a 38,000-acre oligotrophic reservoir. Maximum temperatures of 70° F and a minimum of 3 ppm oxygen were evaluated as criteria for establishing this "two-story" fishery. Stockings of 8 - 10-inch trout were made in the winter months and weight gains were up to threefold in a six month period. Food utilized by the trout was primarily the threadfin shad (Dorosoma petenense). Movement of the trout did not exceed ten miles from the stocking locations, and a majority was caught within five miles. (Authors)

9886. Ratledge, Hayden M. (Div. of Inland Fisheries, North Carolina Wildlife Resources Comm., Raleigh, N. C.). 1967. THE IMPACT OF INCREASING FISHING PRESSURE UPON WILD AND HATCHERY-REARED TROUT POPULATIONS. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 375-379.

Twelve years of trout stream management on the Standing Indian Wildlife Management Area in North Carolina has involved a fixed annual stocking of marked hatchery-reared trout. A complete creel census has been mandatory on the Area streams so that the catch of both stocked and wild trout could be followed. It was concluded from this study that: (1) Wild trout populations deteriorated after two consecutive years of 40 trips per acre per year; (2) Hatchery-reared trout provided only a buffer to the destructive harvest of wild trout up to a point, then when the wild trout have been depleted the hatchery fish became dominant in the harvest; (3) Up to that point, harvest of wild trout, not the harvest of the stocked trout, upheld the trout fishery; and (4) Increased fishing pressure resulted in decreased average catch and catch per hour, whereas, decreased pressure resulted in higher average catches. (Auth.)

9887. Louder, Darrell E., and W. Donald Baker (Div. of Inland Fisheries, North Carolina Wildlife Resources Comm., Raleigh, N. C.). 1967. SOME INTERESTING LIMNOLOGICAL ASPECTS OF FONTANA RESERVOIR. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 380-390.

Fontana Reservoir, located in the mountains of western North Carolina, covers 10,670 surface acres at full pool elevation of 1,710 feet. The reservoir is approximately 29 miles long, has 248 miles of shoreline, a maximum depth of 440 feet, and three influent rivers, the Nantahala, Little Tennessee, and Tuckaseigee. Temperature and chemical profiles were taken monthly from June 1964 through December 1965 at five permanent sampling stations. It was concluded from the study that: (1) During the summer, the Nantahala River water flows below the warmer Little Tennessee and Tuckaseigee River waters; (2) Two steep temperature gradients meeting the requirements of a thermocline definition were formed in Fontana Reservoir during each annual cycle; (3) No significant variations of alkalinity nor carbon dioxide concentrations were found in the reservoir; (4) Anaerobic decomposition of sludge deposits in the Tuckaseigee River arm resulted in the formation of a stratum of anoxic water in the main reservoir; (5) The anoxic water stratum was found to reach the penstocks in October at about the time of the fall overturn; and (6) At least five percent of the total reservoir capacity is removed from fish productivity by a complete absence of oxygen. (Authors)

9888. Carver, Dudley C. 1967. DISTRIBUTION AND ABUNDANCE OF THE CENTRARCHIDS IN THE RECENT DELTA OF THE MISSISSIPPI RIVER. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 390-404.

Distribution and abundance of eight centrarchid fishes were studied on Delta National Wildlife Refuge from August 1963 through January 1965. Gear used to collect the fish included rotenone, gill nets, trammel nets, bag seine, minnow seine and electric shocker. Standing crop samples were conducted using rotenone and block-off nets. Salinity was a major factor which limited distribution of centrarchids on the refuge. Pond depth and turbidity were also factors affecting distribution and abundance. Oxygen, carbon dioxide, pH and alkalinity were found to be within suitable levels for fishes during sampling periods. Spotted sunfish had the most diversified distribution of any centrarchid. Largemouth bass preferred the clearer, deeper waters. Warmouth occurred in more turbid waters than other centrarchids. Centrarchids averaged 32.79 percent of the total standing crop of fishes in area 1, 23.54 percent in area 2 and 4.44 percent in area 3. Centrarchidae represented the second largest family in number of species and first in poundage of fishes occurring on the study area. Redear sunfish, warmouth, spotted sunfish, black crappie and largemouth bass were the most abundant centrarchids in descending order. (Auth.)

9889. Fish, Frederic F. (Div. of Inland Fisheries, North Carolina Wildlife Resources Comm., Raleigh, N. C.). 1967. SPORT FISH STATISTICS FROM THE INLAND WATERS OF NORTH CAROLINA. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 404-408.

Data obtained from 28,454 Wildlife Protector interviews during the course of routine license and creel checks between April 1, 1964 and March 31, 1965 supported the following estimates respecting the "rod-and-reel" sport fishery in the Inland Waters of North Carolina:

Respecting Angler Numbers:
Licensed — 404,878 (53%)
Unlicensed — 357,335 (47%)

Respecting Choice of Gear:
By licensed anglers: cane pole 32%; casting rod 49%; fly rod 9%
By unlicensed anglers: cane pole 64%; casting rod 26%; fly rod 4%
All anglers: cane pole 47%; casting rod 38%, fly rod 7%

Respecting Choice of Baits:
By licensed anglers: natural 63%; artificial 22%
By unlicensed anglers: natural 98%; artificial 1%
By all anglers: natural 80%; artificial 12%
(Balance indicates both baits used on same trip)

Respecting Catches:
The percentage of the estimated Statewide harvest from Inland Waters by "rod-and-reel": sunfishes 44.0%; crappie 19.1%; white perch 12.6%; catfishes 10.0%; largemouth bass 3.6%; mountain trout 3.5%; all others combined 7.2%. (Auth.)

9890. Pfeiffer, Peter W. (Dept. of Fish and Wildlife Resources, Frankfort, Ky.). 1967. THE RESULTS OF A NON-UNIFORM PROBABILITY CREEL SURVEY ON A SMALL STATE-OWNED LAKE. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 409-412.

A non-uniform probability creel survey was conducted in conjunction with a stratified two-hour survey. The methods of each survey are described. Analysis of results in terms of fishing pressure showed that there was no statistically significant difference between the two surveys, but the non-uniform probability survey proved to be 38 percent more efficient. (Auth.)

9891. Bonn, Edward W., and Billy J. Follis (Texas Parks and Wildlife Dept., Denison, Tex.). 1967. EFFECTS OF HYDROGEN SULFIDE ON CHANNEL CATFISH (Ictalurus punctatus). Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 424-432.

The natural production of sulfides is responsible for poor channel catfish production in many acid lakes in Northeast Texas. The TL_m of un-ionized hydrogen sulfide for channel catfish fry ranged from 0.8 ppm at pH of 6.8 to 0.53 at pH 7.8. At pH 7.0 the TL_m of this gas is 1.0 ppm for fingerling catfish, 1.3 for advanced fingerlings and 1.4 for adult channel catfish. Small fish were also killed quicker when exposed to these concentrations. Maximum concentrations of hydrogen sulfide are produced in the spring. Channel catfish populations can be maintained by continued stocking of adult fish or by raising the pH with agricultural limestone, which in turn lowers the toxic un-ionized hydrogen sulfide. (Authors)

9892. Spencer, Sam L. (Alabama Dept. of Conservation, Game and Fish Div., Montgomery, Ala.). 1967. INVESTIGATIONS IN THE USE OF ELECTRICITY FOR THINNING OVERCROWDED POPULATIONS OF BLUEGILL. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 432-437.

A 230-volt, 180-cycle alternating current; a 115-volt, 60-cycle alternating current and a 115-volt direct current were used to attempt to kill intermediate-size bluegill, Lepomis macrochirus Rafinesque, without harming largemouth bass, Micropterus salmoides (Lacepede). Bluegill and largemouth bass were placed in screen pens in concrete ponds and exposed to different voltages, electrode types and exposure periods. No largemouth bass were killed during exposure periods which killed 75 percent of the bluegill. The 230 volts killed more bluegill than 115 volts A.C. or 115 volts D.C. However, 230 volts A.C. did not kill sufficient percentages of bluegill with short (8-10 second) exposures. (Auth.)

9893. Henley, James P. (Dept. of Fish and Wildlife Resources, Frankfort, Ky.). 1967. EVALUATION OF ROTENONE SAMPLING WITH SCUBA GEAR. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 439-446.

Eleven rotenone studies were evaluated with SCUBA gear between 1961-1964 to determine the numbers and weights of fish that do not float to the surface and are not recovered. It was determined that 74% of the number and 95% of the weight of all fishes present in the sample area were recovered on the surface within a 52-hour period. Fingerling fishes represented 91% of the unrecovered population by numbers; intermediates, 6%; and harvestable-size fish, 3%. The species of fish which were lost in the greatest numbers were threadfin shad, brook silverside, gizzard shad, black bass and white crappie, respectively. The highest percentage of recovery occurred during the month of September with the low recorded in August. Species composition and size distribution affected the recovery of the fish more than other factors. (Auth.)

9894. Baker, W. Donald (Div. of Inland Fisheries, North Carolina Wildlife Resources Comm., Raleigh, N.C.). 1967. A "FISH LOK" FOR PASSING FISHES THROUGH SMALL IMPOUNDMENT STRUCTURES. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 457-461.

A method of locking fishes through a model representing a small impoundment structure was tested and found successful. Ten species of fishes were passed both upstream and downstream through two gates which were operated alternately and in such a manner as to provide attracting flows during the entire cycle. (Auth.)

9895. Arnold, John G., Jr., Harry E. Schafer, Donald Geagan, and R. L. Vulliet (Dept. of Medical Technology, Loyola University, New Orleans, La.). 1967. THE PARASITES OF THE FRESH WATER FISHES OF LOUISIANA. I. INCIDENCE AND DISTRIBUTION OF PARASITISM. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 462-468.

This survey of the parasites of the freshwater fishes of Louisiana was undertaken in 1960. Field collections from 54 localities were continued until 1962. Included in this study were 1,807 fishes belonging to 17 families and 52 species. Of these, 1,093, or 60.4%, were found to be parasitized. An analysis of this group showed the following degrees of parasitism—694 fishes with trematodes—38.4%; 446 fishes with nematodes—24.7%; 385 fishes with acanthocephalans—21.3%; and 27 fishes with such forms as leeches and arthropods—1.4%. (Authors)

9896. Applegate, Richard L., James W. Mullan, and David I. Morais (Bur. of Sport Fisheries and Wildlife, Fayetteville, Ark.). 1967. FOOD AND GROWTH OF SIX CENTRARCHIDS FROM SHORELINE AREAS OF BULL SHOALS RESERVOIR. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 469-482.

Stomach contents were examined from 579 longear sunfish, 381 green sunfish, 173 bluegill, 206 largemouth bass, 264 smallmouth bass, and 328 spotted bass collected from the shoreline area of Bull Shoals Reservoir, April 1964 - March 1965. The food of the six species by seasons and size groups (0-1.9, 2.0-3.9, 4.0-7.9 and 8.0 plus inches) is presented. Fish contributed 85 to 99% of the total volume of food of the black basses four inches or more in length. Threadfin and gizzard shad were the most common prey species (50% or more of the volume). Consumption of longear, green, and bluegill sunfish by the basses was also significant (19% of volume). Longear sunfish over four inches in length relied heavily on

terrestrial insects (37%), green sunfish on crayfish (63%), and bluegill on terrestrial insects (23%) and filamentous algae (23%). Utilization of fish by the larger sunfishes was minor, except for heavy consumption of dead or dying threadfin shad during a winter mortality. The same species of Entomostraca and aquatic insects found only in the littoral browsing area constituted the primary foods of all six species of centrarchids under four inches in length, with greatest utilization by those under two inches. Basses, two to four inches in length, included fish in their diets. All the sunfishes consumed large quantities of black bass eggs in May. Bryozoa were seasonally important in the diets of longear and bluegill sunfish. Growth of these centrarchids in Bull Shoals Reservoir was slow compared with that of the same species in other U.S. waters. (Authors)

9897. Prather, E.E. (Auburn Univ. Agricultural Experiment Station, Auburn, Ala.). 1967. A NOTE ON THE ACCURACY OF THE SCALE METHOD IN DETERMINING THE AGES OF LARGEMOUTH BASS AND BLUEGILL FROM ALABAMA WATERS. Proc. 20th Ann. Conf. stheast. Ass. Game Commrs., 483-487.

Photographic prints were made of scales taken from largemouth bass (Micropterus salmoides Lacepede) and bluegill (Lepomis macrochirus Rafinesque) of known ages by the use of a micro-projection machine. The image of each scale was projected directly upon photographic paper to produce, upon development, a permanent negative print. In an examination of the prints of 272 largemouth bass scales, 80.1 percent were aged correctly when the ages were unknown to the technician. When the scales first aged incorrectly were re-examined after the technician knew the actual ages, an additional 3.7 percent was found to have the correct number of annuli although many were indistinct. A total of 16.2 percent of the bass scales did not possess annuli corresponding to the known ages. In an examination of 264 prints of the scales of bluegill, 76.1 percent were aged correctly when the ages were unknown. When the scales first aged incorrectly were re-examined after the technician knew the actual ages, an additional 4.9 percent was found to have the correct number of annuli; however, many were not distinct. Of the total number of bluegill scales studied, 18.9 percent did not possess annuli corresponding to the known ages. (Auth.)

9898. Lyles, Charles H. 1967. FISHERY STATISTICS OF THE UNITED STATES 1965. Bureau of Commercial Fisheries Statistical Digest 59. 756 p.

9899. Hunt, Robert L. 1968. EFFECTS OF HABITAT ALTERATION ON PRODUCTION, STANDING CROPS AND YIELD OF BROOK TROUT IN LAWRENCE CREEK, WISCONSIN. Wisconsin Dept. of Natural Resources Research Report No. 31. 45 p.

The upper mile of Lawrence Creek was intensively altered by the addition of stream bank covers and current deflectors during 1964. These alterations reduced the surface area by 50%, increased the average depth by 60%, increased the number of pools by 52%, and increased the amount of permanent, overhanging bank cover for trout by 416%. Alteration reduced the amount of sandy bottom by 40%, silty bottom was reduced by 70%, and gravel bottom was increased by 11%. The management objective of the habitat alteration was improvement of the sport fishery by increasing the number of naturally produced legal-sized trout. Production and standing crops of trout before and after alteration were also used as comparative indices to assess responses of the trout population to habitat alteration. Food consumption by the trout population and quantitative and qualitative changes in standing crops of benthic invertebrates were also determined. Data from 3 years prior to alteration and from 3 years after alteration compared as follows: The average number of legal-sized trout present when the fishing season began increased by 100% after alteration; annual production increased by 17% on an absolute basis and by 140% on a unit area basis after alteration. Adults accounted for 66% of annual production after alteration, but only 55% before alteration; The average biomass of trout increased by 40% on an absolute basis and by 188% on a unit area basis after alteration. Adults accounted for 87% of the average biomass after alteration but only 78% before alteration; food consumption increased by 28% on an absolute

basis and by 162% on a unit area basis after alteration. Yield increased by 196% on an absolute basis and by 510% on a unit area basis after alteration. Improvements in the trout population after habitat alteration appeared to be largely the result of increased rates of overwinter survival rather than greater recruitments of young trout to the population or to increased growth rates. Changes in production and standing crops were greater for adult trout than for young-of-the-year trout. (Auth.)

9900. Fenderson, Owen C., W. Harry Everhart, and Kenneth M. Muth (Maine Dept. of Inland Fisheries and Game, Enfield, Me.). 1968. COMPARATIVE AGONISTIC AND FEEDING BEHAVIOR OF HATCHERY-REARED AND WILD SALMON IN AQUARIA. J. Fish. Res. Bd. Canada, 25(1): 1-14.

When hatchery-reared and wild landlocked Atlantic salmon (Salmo salar) parr of the same age and size were permitted to compete for social dominance and for food in aquaria, twice as many hatchery salmon attained dominance as wild salmon. Dominant hatchery salmon also showed a higher intensity of aggressiveness than dominant wild salmon, displaying a higher and more variable mean nipping rate. Socially dominant salmon ate more food per fish than subordinates, but there were no statistically significant differences in feeding rate between dominant hatchery and dominant wild salmon, or between subordinate hatchery and subordinate wild salmon. Hatchery salmon displayed lower feeding rates than wild salmon when they were held in separate compartments of an aquarium and compared at three temperatures. This difference in feeding rate probably was not a reflection of differences in adaptation to temperature or food preference, but, rather, was the result of interference with feeding caused by the more intense social interaction among hatchery fish. It is suggested that high levels of aggressiveness may contribute to mortalities of hatchery-reared salmon planted in streams because of loss of feeding time, excessive use of energy, and increased exposure to predators. (Authors)

9901. Caillouet, Charles W., Jr. (Dept. of Zoology and Entomology, Iowa State Univ., Ames, Iowa). 1968. LACTIC ACIDOSIS IN CHANNEL CATFISH. J. Fish. Res. Bd. Canada, 25(1): 15-23.

Channel catfish (Ictalurus punctatus) were subjected to 5 or 10 minutes of anoxia (removed from water) to rapidly increase blood lactic acid concentration metabolically. Blood pH decreased as blood lactic acid concentration increased. Respiratory rate increased in fish with lowered blood pH and with increased blood lactic acid concentration during the 10 minutes after fish were returned to water after anoxia. Fish not treated had a mean blood pH of 7.8. Blood pH decreased in catfish subjected to anoxia 5, 10, and 15 minutes and decreased further when the fish were returned to water. Lowered blood pH was associated with loss of equilibrium and death in catfish subjected to transportation and handling. (Auth.)

9902. Hunn, Joseph B., Richard A. Schoettger, and Wayne A. Willford (Bur. of Sport Fisheries and Wildlife, Fish Control Lab., La Crosse, Wisc.). 1968. TURNOVER AND URINARY EXCRETION OF FREE AND ACETYLATED M.S. 222 BY RAINBOW TROUT, Salmo gairdneri. J. Fish. Res. Bd. Canada, 25(1): 25-31.

Rainbow trout (Salmo gairdneri) anesthetized in 100 mg/liter of M.S. 222 at 12° C excreted the drug in free and acetylated forms via the urine during a 24-hour recovery period in freshwater. Of the M.S. 222 excreted, 77-96% was acetylated. Blood levels of free drug in anesthetized trout approximated 75% of the anesthetic concentration, but the amount of acetylated M.S. 222 was relatively insignificant. The blood and urine were cleared of the two fractions of M.S. 222 in 8 and 24 hours respectively. Low levels of aromatic amines of natural origin occurred in blood and urine and were subtracted from measurements of M.S. 222. Intraperitoneal injections of 10-100 mg/kg of M.S. 222 did not induce anesthesia; however, the 24-hour pattern of drug excretion was similar to that observed after anesthesia by immersion. Only 15-21% of the injected dose was found in the urine, suggesting a second route of drug elimination. (Authors)

9903. Hartman, G. F., and C. A. Gill (Fish and Wildlife Branch, Fisheries Research Div., c/o Inst. of Fisheries, Univ. of British Columbia, Vancouver, B. C., Canada). 1968. DISTRIBUTIONS OF JUVENILE STEELHEAD AND CUTTHROAT TROUT (Salmo gairdneri AND S. clarki clarki) WITHIN STREAMS IN SOUTHWESTERN BRITISH COLUMBIA. J. Fish. Res. Bd. Canada, 25(1): 33-48.

Trout were collected and identified from 66 streams or stream systems of different size and gradient. Total dissolved solids (T. D. S.) and pH were determined on most streams. Size and profile of streams to a large degree determined the species of trout present. Large streams, with drainage area over 130 km^2, were predominantly occupied by steelhead. Small streams, drainage area under 13 km^2, were predominantly occupied by cutthroat. Streams less than 120 km^2 in drainage area with steep gradients, and emptying directly into the sea, usually supported steelhead, as did large rivers. Those which dropped steeply and then levelled and ran through several miles of sloughs usually supported cutthroat. Where both species occurred, cutthroat were most often predominant in the small tributaries and headwaters, and steelhead in the lower reaches of the main stream. Stream pH's were usually lower in winter than in summer, but had no obvious effect on trout distribution. Many cutthroat streams had high T. D. S. readings in the lower reaches in summer and low T. D. S. readings in these areas in winter. Otherwise there were no marked differences between steelhead and cutthroat streams in terms of T. D. S. (Authors)

9904. Dahlberg, Michael L., Dean L. Shumway, and Peter Doudoroff (Dept. of Fisheries and Wildlife, Oregon State Univ., Corvallis, Oreg.). 1968. INFLUENCE OF DISSOLVED OXYGEN AND CARBON DIOXIDE ON SWIMMING PERFORMANCE OF LARGEMOUTH BASS AND COHO SALMON. J. Fish. Res. Bd. Canada, 25(1): 49-70.

The final swimming speed of juvenile largemouth bass, Micropterus salmoides (Lacepede), was reduced markedly at oxygen concentrations below 5 or 6 mg/liter in tests at 25° C in a tubular chamber in which the velocity of water was increased gradually, at 10-minute intervals, until the fish were forced by the current permanently against a screen. At levels above 6 mg/liter, the final swimming speed was virtually independent of the oxygen concentration. The performance of bass that had been acclimated overnight to elevated carbon dioxide levels was not materially affected by the highest tested concentrations of free carbon dioxide, averaging 48 mg/liter, at any tested level of dissolved oxygen. For juvenile coho salmon, Oncorhynchus kisutch (Walbaum), at temperatures near 20° C and carbon dioxide concentrations near 2 mg/liter, any considerable reduction of the oxygen concentration from about 9 mg/liter, the air-saturation level, resulted in some reduction of the final swimming speed. The performance of the salmon was impaired much more markedly than was that of the bass by the same reduction of the oxygen concentration. At oxygen concentrations near and above the air-saturation level, high concentrations of free carbon dioxide averaging 18 and 61 mg/liter had a depressing effect on the final swimming speed of coho salmon even after overnight acclimation. However, this effect decreased at reduced oxygen concentrations. No measurable effect of free carbon dioxide concentrations near 61 mg/liter was evident at 2 mg/liter dissolved oxygen, and concentrations near 18 mg/liter had little or no effect even at moderately reduced dissolved oxygen levels after overnight acclimation of the salmon to these carbon dioxide concentrations. (Authors)

9905. Donaldson, Edward M., Ulf H. Fagerlund, and Peter J. Schmidt (Fisheries Research Board of Canada, Vancouver Lab., Vancouver, B. C., Canada). 1968. FLUORIMETRIC METHOD FOR THE DETERMINATION OF CORTISOL IN SMALL QUANTITIES OF SALMONID PLASMA. J. Fish. Res. Bd. Canada, 25(1): 71-79.

A method is described for the fluorimetric determination of cortisol in 1-ml aliquots of salmonid plasma. Validation experiments are presented which indicate that the reliability of the method is satisfactory. The method provides the means for the determination of low cortisol concentrations, such as those encountered in hypophysectomized or resting salmonids (0.01-0.05 μg/ml). (Authors)

9906. Halsey, T.G. (Fisheries Research Div., British Columbia Fish and Wildlife Branch, c/o Inst. of Fisheries, Univ. of British Columbia, Vancouver, B.C., Canada). 1968. AUTUMNAL AND OVER-WINTER LIMNOLOGY OF THREE SMALL EUTROPHIC LAKES WITH PARTICULAR REFERENCE TO EXPERIMENTAL CIRCULATION AND TROUT MORTALITY. J. Fish. Res. Bd. Canada, 25(1): 81-99.

The autumnal and over-winter limnological characteristics of two small eutrophic lakes differed considerably from those of a third eutrophic lake; all were close to each other in the southwest interior of British Columbia. Thermal and chemical stratification was well defined in Marquette and Corbett lakes because local topography provided protection from wind action; stratification in the more exposed Courtney Lake was ill defined. Average wind velocities during summer and autumn on Courtney Lake were 4.3 times as great as, and more unidirectional than, those on Corbett Lake and probably Marquette. Complete natural autumnal oxygenation and circulation in Courtney Lake provided comparatively high concentrations of dissolved oxygen which permitted the over-winter survival of Salmo gairdneri and Richardsonius balteatus. Although Marquette and Corbett Lakes were isothermal in late autumn, oxygen concentrations were well below saturation levels and circulation was probably incomplete. Consequently oxygen depletion during winter was severe and S. gairdneri and Salvelinus fontinalis were subject to over-winter mortality. Experimental circulation of Corbett Lake, just prior to ice cover, confirmed the hypothesis that incomplete autumnal oxygenation is a cause of "winter kill" of fishes. Artificial autumnal circulation of the lake provided an oxygen concentration sufficient to prevent over-winter fish mortality. However, over-winter mortality of the entire fish population did occur in the control lake, Marquette (incomplete autumnal oxygenation) but not in Courtney Lake (complete autumnal oxygenation). (Auth.)

9907. Nelson, J.S. (Inst. of Fisheries, Univ. of British Columbia, Vancouver, B.C., Canada). 1968. HYBRIDIZATION AND ISOLATING MECHANISMS BETWEEN Catostomus commersonii AND C. macrocheilus (PISCES: CATOSTOMIDAE). J. Fish. Res. Bd. Canada, 25(1): 101-150.

Catostomus commersonii and C. macrocheilus are sympatric in three major drainages of British Columbia. Morphological analysis employing a character index and discriminant function analysis of allopatric and sympatric populations revealed that hybrids were in 9 of the 11 lakes examined in which both species occurred. Presumed F_1 hybrids made up an average of 7% of the individuals of the combined populations where hybrids occurred. There was no evidence of backcrossing or swamping. Segregation in spawning time and habitat was not apparent in four confined inlets which have migrations of both species. Some lakes supporting both species were found to have inlets in which only one species spawned. Temporal isolation was absent but habitat isolation was present in some areas of Cluculz River, an outlet with diversified habitat. Where segregation was apparent, C. commersonii spawned in shallow gravelly areas and C. macrocheilus in deep sandy areas. Artificial crosses of the species, two backcrosses involving hybrid females, and microscopic examination of hybrid testes failed to show any effective postmating isolating mechanism. An interaction of temporal, habitat, and postmating isolating mechanisms was not considered sufficient to prevent swamping. Ethological isolation is inferred to be of major importance in reducing initial hybridization. No explanation was found for the apparent failure of hybrids to successfully reproduce. Hybridixation could not be attributed to environmental factors commonly associated with this phenomenon. Males of one species entering the spawning act with males and a female of the other species is considered the main cause of hybridixation. Mis-mated individuals, however, have much opportunity for conspecific matings at other times. There was no evidence of reinforcement of isolating mechanisms despite the probable occurrence of hybridization in some areas for at least several hundred years. Characters of each species were as distinctive in the areas of sympatry as in the areas of allopatry. Natural selection against individuals producing hybrids is apparently slow. (Auth.)

9908. Smith, Charlie E. (Western Fish Nutrition Lab., Bur. of Sport Fisheries and Wildlife, Cook, Wash.). 1968. HEMATOLOGICAL CHANGES IN COHO SALMON FED A FOLIC ACID DEFICIENT DIET. J. Fish. Res. Bd. Canada, 25(1): 151-156.

Coho salmon (Oncorhynchus kisutch) fed a diet deficient in folic acid for 24 weeks developed megaloblastic, normochromic macrocytic anemia. The anemia was further characterized by the presence of poikilocytic erythrocytes which were observed in stained preparations of peripheral blood. These abnormally shaped cells appear to be an important aid in the identification of folic acid deficiency. The anemia disappeared when the deficient fish were fed a recovery diet containing folic acid for 8 weeks. (Auth.)

9909. Houston, A.H., and Mary Anne DeWilde (Dept. of Biology, Marquette Univ., Milwaukee, Wisc.). 1968. HEMATOLOGICAL CORRELATIONS IN THE RAINBOW TROUT, Salmo gairdneri. J. Fish. Res. Bd. Canada, 25(1): 173-176.

9910. Beckett, J.S. (Fisheries Research Board of Canada Biological Station, St. Andrews, N.B., Canada). 1968. A HARPOON ADAPTER FOR TAGGING LARGE FREE-SWIMMING FISH AT THE SURFACE. J. Fish. Res. Bd. Canada, 25(1): 177-179.

9911. Duffy, J.R., and D. O'Connell (St. Dunstan's Univ., Charlottetown, P.E.I., Canada). 1968. DDT RESIDUES AND METABOLITES IN CANADIAN ATLANTIC COAST FISH. J. Fish. Res. Bd. Canada, 25(1): 189-195.

9912. Smith, M.W., and J.W. Saunders (Fisheries Research Board of Canada Biological Station, St. Andrews, N.B., Canada). 1968. EFFECT OF POND FORMATION ON CATCHES OF BROOK TROUT FROM A COASTAL STREAM SYSTEM. J. Fish. Res. Bd. Canada, 25(2): 209-238.

An artificial 5-acre (2.0-ha) pond formed on Ellerslie Brook, Prince Edward Island, initially resulted in an increased fishing effort and yield of brook trout to anglers from the stream system—estuary, pond, and stream. The increased effort and catch were not sustained. After 4 years, annual effort and yield of trout by number from the system were not significantly different from the pre-pond period. Length of angled trout and yield by weight declined significantly. Sea-running trout, prized by anglers, were largely eliminated. Only when planted into the estuary did hatchery-reared trout make good contributions to the anglers' catches. (Authors)

9913. Lawler, G.H., and M. Fitz-Earle (Fisheries Research Board of Canada, Freshwater Inst., Winnipeg, Man., Canada). 1968. MARKING SMALL FISH WITH STAINS FOR ESTIMATING POPULATIONS IN HEMING LAKE, MANITOBA. J. Fish. Res. Bd. Canada, 25(2): 255-266.

For estimating populations of trout-perch, Percopsis omiscomaycus (Walbaum), by immersing fish in solutions of stains, Bismarck brown Y was superior to two other stains tested. It was satisfactory for periods of marking up to 1 week. Neutral red indicator can be used in marking experiments of less than 2 days' duration but Nile blue A faded rapidly and is not recommended for use in estimating populations. Using multiple and single census methods of estimating population size, the most reliable estimates of trout-perch greater than 46 mm in length were 711,451 (Schnabel) and 883,148 (Petersen), or in number per acre 1,186-1,472. (Authors)

9914. Keast, Allen (Dept. of Biology, Queen's Univ., Kingston, Ont., Canada). 1968. FEEDING BIOLOGY OF THE BLACK CRAPPIE, Pomoxis nigromaculatus. J. Fish. Res. Bd. Canada, 25(2): 285-297.

In Lake Opinicon, Ontario, the diet of the black crappie, Pomoxis nigromaculatus, undergoes a progressive change from one in which planktonic Crustacea and small-bodied Diptera larvae predominate (in fish of body length from about 60 to 115 mm), to a diet of insect larvae and fish (in fish 160-240 mm). Most food items prove to be midwater forms and the Diptera larvae are almost entirely Chaoborus

and Procladius, which are free-swimming in the water column at night. An unusual feature is the prolonged nature of the Cladocera-Copepoda eating phase, which continues into year III and to a body length of about 160 mm. Gill-raker counts show P. nigromaculatus to have a specialized screen with 25-29 rakers on the first arch. In this it differs from cohabiting centrarchids in Lake Opinicon, Ambloplites rupestris, Micropterus salmoides, and Lepomis macrochirus, in which the rakers on the first arch number only 8-12. In these species plankton feeding is restricted to the earlier stages. (Auth.)

9915. Kabata, Z. (Fisheries Research Board of Canada Biological Station, Nanaimo, B. C., Canada). 1968. SOME CHONDRACANTHIDAE (COPEPODA) FROM FISHES OF BRITISH COLUMBIA. J. Fish. Res. Bd. Canada, 25(2): 321-345.

This paper redescribes three species of Chondracanthidae (Copepoda) parasitic on the fishes of British Columbia and previously recorded by earlier writers (Chondracanthus irregularis, Ch. pinguis, and Ch. gracilis). Two new species are described (Ch. pusillus and Acanthochondria holocephalarum). Finer structural details of the chondracanthid appendages are illustrated and the taxonomic status of the previously known species is discussed. (Auth.)

9916. Truscott, B., D.R. Idler, R.J. Hoyle, and H. C. Freeman (Fisheries Research Board of Canada, Halifax Lab., Halifax, N.S., Canada). 1968. SUB-ZERO PRESERVATION OF ATLANTIC SALMON SPERM. J. Fish. Res. Bd. Canada, 25(2): 363-372.

Non-frozen storage of sperm for several weeks was achieved by the use of buffered protective agents and low temperature. For example, sperm stored with 5% dimethyl sulphoxide at -4.5° C for 28 days gave 81% fertility; use of 5% ethylene glycol allowed storage at -3° C for 38 days, giving 70% fertility. It is suggested how these results may be employed for interspecific mating of salmonids. Attempts to employ glycerol as a protective agent were unsuccessful as were all attempts at freezing sperm. The necessity of providing an adequate air-space in vials used for short-term storage of undiluted sperm of Atlantic salmon is demonstrated. Although a rough correlation between motility of sperm and fertilization is reported, caution in the interpretation of motility as an indication of fertility is suggested. (Authors)

9917. John, Kenneth R., and David M. Gring (Franklin and Marshall College, Lancaster, Pa.). 1968. RETINOMOTOR RHYTHMS IN THE BLUEGILL, Lepomis macrochirus. J. Fish. Res. Bd. Canada, 25(2): 373-381.

Bluegills, Lepomis macrochirus, entrained to natural or artificial light-dark cycles, were confined to constant darkness for varying periods up to 42 hours at temperatures in the range 20-25° C. The retinomotor activities were determined from histological preparations. In the first night, the eyes became maximally dark-adapted within 1 or 2 hours. The pigment was contracted to a dense basal band, twin cones extended to the boundary of the pigment, and single cones extended into the pigment. After 2 or 3 hours in darkness, these components began a return toward their light-adapted positions, slowly for 5 or 6 hours, and then rapidly during the last 3 or 4 hours, and came to rest in an intermediate state of adaptation at subjective sunrise. In continuous darkness, the retina exhibited a rudimentary free-running rhythm, and there was some evidence of a 12-hour oscillation within the 24-hour period. The amplitudes of the rhythms ranged in decreasing order from twin cones to single cones to pigment and the extreme amplitudes occurred about 2 hours after sunset and at subjective sunrise. Single cones were always more extended than twin cones and only the rod-shaped particles, not the spheres, of pigment appeared to cycle. By the end of the experiment, the rhythms of cones were slightly damped and the rhythm of the pigment was greatly damped. Rods were not studied. (Authors)

9918. Wolf, Ken, M. C. Quimby, C. P. Carlson, and G. L. Bullock (Bur. of Sport Fisheries and Wildlife, Eastern Fish Disease Lab., Kearneysville, W. Va.). 1968. INFECTIOUS PANCREATIC NECROSIS: SELECTION OF VIRUS-FREE STOCK FROM A POPULATION OF CARRIER TROUT. J. Fish. Res. Bd. Canada, 25(2): 383-391.

Infectious pancreatic necrosis (IPN) is a virulent disease of young trouts and is easily transmitted from infected animals through water and with eggs. At present, the most effective control measure consists of propagation of specific pathogen-free stock. Methods are described for using fish cell cultures to detect IPN virus in peritoneal washes, feces, and gonadal fluids and thereby to identify carrier and non-carrier fish. The procedures were used to derive virus-free progeny from a hatchery trout population containing about one-third carrier fish. The progeny were reared to maturity, spawned for 3 successive years, and at each spawning they proved free of virus. Recommendations and precautions are given for those who may wish to apply the procedures. (Authors)

9919. Hunter, John R. (Bur. of Commercial Fisheries, Fishery-Oceanography Center, La Jolla, Calif.). 1968. EFFECTS OF LIGHT ON SCHOOLING AND FEEDING OF JACK MACKEREL, Trachurus symmetricus. J. Fish. Res. Bd. Canada, 25(2): 393-407.

Schools of six jack mackerel each were photographed with infrared film at eight levels of luminance and also in darkness. Three indices were used to measure the behavior of the school from motion pictures. Two of the indices, mean distance to nearest neighbor and mean separation distance, were measures of the distances between individuals in a school; the other, mean angular deviation, was a measure of differences in orientation between individuals. A value for each index was calculated for each motion picture frame. From 12.1 to 6 x 10^{-6} ft-L no differences existed in the angular deviation of the school or in the distances between fish. At 6 x 10^{-7} ft-L the intervals between fish were much larger than at higher levels of brightness and groups showed little uniformity in their orientation. Below 6 x 10^{-7} ft-L (darkness) schools were dispersed and the distributions of values of angular deviation were random. The ability of jack mackerel to feed on live adult Artemia was also tested at eight levels of luminance and in darkness. The number of Artemia eaten at 6 x 10^{-5} ft-L was about half of that eaten at the normal daytime level of 12.1 ft-L. Few Artemia were eaten at 6 x 10^{-7} ft-L and none in darkness. Comparison of these data with measurements of light in the sea indicated that jack mackerel probably would be able to maintain schools near the surface on a moonless starlit night and that they probably could feed effectively near the surface on a full moonlight night. (Auth.)

9920. Nelson, Joseph S. (Univ. of British Columbia, Vancouver, B.C., Canada). 1968. DISTRIBUTION AND NOMENCLATURE OF NORTH AMERICAN KOKANEE, Oncorhynchus nerka. J. Fish. Res. Bd. Canada, 25(2): 409-414.

9921. Nelson, Joseph S. (Univ. of British Columbia, Vancouver, B.C., Canada). 1968. VARIATION IN GILLRAKER NUMBER IN NORTH AMERICAN KOKANEE, Oncorhynchus nerka. J. Fish. Res. Bd. Canada, 25(2): 415-420.

9922. Campbell, Gordon, and R. M. MacKelvie (Fisheries Research Board of Canada, Halifax Lab., Halifax, N.S., Canada). 1968. INFECTION OF BROOK TROUT (Salvelinus fontinalis) BY NOCARDIAE. J. Fish. Res. Bd. Canada, 25(2): 423-425.

9923. Truscott, B., and D. R. Idler (Fisheries Research Board of Canada, Halifax Lab., Halifax, N.S., Canada). 1968. BIOSYNTHESIS OF ALDOSTERONE AND 18-HYDROXYCORTICOSTERONE FROM CORTICOSTERONE BY INTERRENAL TISSUE OF A TELEOST (Clupea harengus harengus). J. Fish. Res. Bd. Canada, 25(2): 431-435.

9924. Taylor, F. H. C. (Fisheries Research Board of Canada Biological Station, Nanaimo, B. C., Canada). 1968. THE RELATIONSHIP OF MIDWATER TRAWL CATCHES TO SOUND SCATTERING LAYERS OFF THE COAST OF NORTHERN BRITISH COLUMBIA. J. Fish. Res. Bd. Canada, 25(3): 457-472.

In 1964 and 1965 three midwater trawl cruises off the continental slope near the Queen Charlotte Islands were made to study the relationship of the catches to sound scattering layers. During the daytime four layers were distinguished, not all necessarily present at one time. In summer the most intense and persistent layer lay at 220-230 m; others were at 330-400, 185, and 90 m. In fall the main and deep layers were shallower. Vertical migration occurred at dusk and dawn. The main layer frequently split into three parts with different vertical migration patterns. At dawn a layer gradually appeared at about 90 m, intensified rapidly, and descended to the daytime level. Catches show fishes are associated with the sound scattering layers. The largest day catches were from the main layer. At night fish did not appear to be concentrated to the same extent relative to the layers. The largest night catches were usually smaller than the largest day catches and shallower. Myctophids of eight species, four common, made up 80% of the catch, chauliodontids 6%, argentinids 4%, melamphids, rockfish, and larval flatfish 2% each. The remaining 2% comprised 27 species in 21 families. Depth distribution and vertical migration varied considerably with the species. Myctophids with gas-filled swim bladders were apparently dominant in the main layers whereas species without swim bladders—stomiatoids, argentinids, and melamphids—or myctophids with fat-filled swim bladders were dominant below the main layer and in the deep layer. Fish with no swim bladders or with fat-filled ones may make longer vertical migrations than those with gas-filled bladders. (Auth.)

9925. Gronlund, William D., Harold O. Hodgins, Raymond C. Simon, and Douglas D. Weber (Bur. of Commercial Fisheries Biological Laboratory, Seattle, Wash.). 1968. BLOOD LACTATE CONCENTRATIONS AND MORTALITY IN SOCKEYE AND CHINOOK SALMON (Oncorhynchus nerka AND O. tshawytscha) AFTER EXERCISE. J. Fish. Res. Bd. Canada, 25(3): 473-484.

Blood lactate concentrations in 306 sockeye salmon (Oncorhynchus nerka), taken at sea in 1965 and 1966 by purse seine, gillnet, and longline, and in 98 starved or fed immature chinook salmon (O. tshawytscha) that had been exercised in a saltwater pond were generally below those reported in the literature as related to stress-induced mortality in salmon. No sockeye salmon held in shipboard tanks for observation died within 2 days after capture, although most of the fish died later. Few fish died among starved or fed immature chinook salmon in salt water within 10 days after capture by hook and line or after being chased to exhaustion; blood lactate concentrations in these fish were generally higher than in sockeye salmon after stress but were still usually below the reported critical level of 125 mg/100 ml. We concluded that neither the adult sockeye nor immature chinook salmon suffered immediate fatigue-related mortality, but the possibility that fatigue could induce delayed mortality was not excluded. (Authors)

9926. Kerns, Orra E., Jr., and John R. Donaldson (Fisheries Research Inst., College of Fisheries, Univ. of Washington, Seattle, Wash.). 1968. BEHAVIOR AND DISTRIBUTION OF SPAWNING SOCKEYE SALMON ON ISLAND BEACHES IN ILIAMNA LAKE, ALASKA, 1965. J. Fish. Res. Bd. Canada, 25(3): 485-494.

In 1965, spawning was studied on the island beaches of the eastern part of Iliamna Lake from a 5.5-m tower mounted on a 9.1-m boat and with the use of SCUBA. Over 3 million sockeye salmon, Oncorhynchus nerka (Walbaum), utilized nearly 130 ha of the beaches surveyed during the period August 8-21. The total spawning population and utilized area of shoreline of all the islands in the lake were greater since each area was surveyed only once and possible multiple waves of spawners were not taken into account, and not all of the island shoreline was surveyed by the above methods. The salmon generally spawned in dense groups, over immovable rock, in exposed areas with no upwelling ground water, and with little display of territorial defense. Density ranged from less than 0.1 fish to more than 5 fish per 0.84 m^2 (1 $yard^2$). The latter density prevailed on reefs and

outside points of the islands. Seventy-three percent of spawning took place over bottom with irrgular rocks from 102 to 305 mm (4-12 inches) in diameter, and over 90% at depths from 2 to 6 m (6-20 ft) on bottom with slopes from 15 to 25°. Commonly, in a group of fish, one or more of the females were seen with their vents down in rock interstices, emitting eggs, while the males in close proximity were observed releasing milt. Eggs on the beaches are probably aerated by wind-generated lake currents and seiches. Of 3,553 eggs collected from several island beaches, 6.8% were infertile. Several features of the spawning behavior and environment are favorable to the survival of eggs and fry. The bottom is not scoured. Most eggs are deposited between immovable rocks and are thus not disturbed by subsequent spawners. Fry emerging from the beaches have immediate access to the large food supply in the lake. Some hazards are predation on eggs by fishes, freezing, and ultraviolet radiation of eggs in shallow water, and smothering in areas with a high density of eggs or algal growth. (Authors)

9927. Alderdice, D. F., and C. R. Forrester (Fisheries Research Board of Canada Biological Station, Nanaimo, B. C., Canada). 1968. SOME EFFECTS OF SALINITY AND TEMPERATURE ON EARLY DEVELOPMENT AND SURVIVAL OF THE ENGLISH SOLE (Parophrys vetulus). J. Fish. Res. Bd. Canada, 25(3): 495-521.

Eggs of the English sole were incubated at a number of salinity-temperature conditions within the ranges of 10-40‰ salinity (S) and 2-12° C. Temperatures of 2° C were lethal in all cases. Development time from fertilization to 50% hatch ranged from 3.5 days (12° C) to 11.8 days (4° C) and was shortest at salinities around 25‰ between temperatures of 6-12° C. Larvae were classified as viable (normal) or abnormal on the basis of several subjective criteria. Response surfaces were computed and salinity-temperature conditions were estimated at which several responses were maximized, namely: larval size, 28.1‰, 7.9° C; total hatch, 25.6‰, 9.0° C; viable hatch, 25.9‰, 8.4° C. In general, optimum conditions for survival appeared to be associated with salinities and temperatures of 25-28‰ and 8-9° C. Temperatures associated with the production of 50% viable hatch or better at optimum salinity conditions (25.9‰) were calculated to be those bounded by 4.5 and 12.5° C. Incidental observations were obtained in several cases on egg density and oxygen consumption. At 30‰ S, 6° C, eggs floated for about 93% of the incubation period and sank just prior to hatching. Salinities of neutral buoyancy of these eggs rose from 27.8‰ at fertilization to 30.8‰ at hatching. Oxygen consumption tests and calculation of rates of oxygen transfer to the eggs indicated that rates of development were independent of oxygen availability in all tests. Several inferences are drawn from the experimental evidence regarding effects of salinity and temperature on distribution and abundance. Over the geographic range of the species, salinity would appear to have little influence on egg viability. Temperature, however, may limit abundance at the northern and southern boundaries of the range of commercial exploitation by lowering egg viability, and be lethal to eggs near the boundaries of geographic distribution. (Authors)

9928. Brown, Seward R. (Dept. of Biology, Queen's Univ., Kingston, Ont., Canada). 1968. ABSORPTION COEFFICIENTS OF CHLOROPHYLL DERIVATIVES. J. Fish. Res. Bd. Canada, 25(3): 523-540.

Methods are described for the isolation of chlorophylls a and b, and for the preparation of 12 chlorophyll derivatives, including crystalline pheophorbide a, from these starting compounds. Laboratory cultures of Chlorella were fed $C^{14}O_2$. After 9 days growth the cells were heat-killed, their pigments extracted, and chlorophylls a and b isolated chromatographically. The following C^{14}-labelled compounds were prepared: chlorophyll a, allomerized chlorophyll a, chlorophyllide a, pheophytin a, allomerized pheophytin a, pheophorbide a, methyl pheophorbide a, chlorophyll b, chlorophyllide b, methyl chlorophyllide b, allomerized chlorophyllide b, allomerized methyl chlorophyllide b, pheophorbide b, and allomerized pheophorbide b. Assuming uniform distribution of carbon-14 label in the parent chlorophyll molecules, specific and molar absorption coefficients were calculated from the specific radioactivities of these derivatives. (Auth.)

9929. Paloheimo, J.E., and A.C. Kohler (Fisheries Research Board of Canada, Marine Ecology Lab., Bedford Inst., Dartmouth, N.S., Canada). 1968. ANALYSIS OF THE SOUTHERN GULF OF ST. LAWRENCE COD POPULATION. J. Fish. Res. Bd. Canada, 25(3): 555-578.

The Gulf of St. Lawrence cod stock supports a fishery with recent annual landings around 65,000 metric tons. Traditionally, fish have been taken by baited hooks, but beginning in 1947 trawl fishing has gradually become the major fishing method. Introduction of trawling with concurrent increase in landings from an average of 30,000 metric tons prior to 1947 to 65,000 metric tons since then appears to have greatly changed the composition of the stock. The changes were characterized by the lowering of the average size of fish and of the abundance in weight of the commercially fished sizes, and the increasing of the abundance of the pre-commercial sizes. Available statistics permit estimation of growth, recruitment, and productivity parameters for the stock. Analysis suggests an inverse relationship between stock density and both growth and recruitment, the overall effect being an increased productivity. If the observed population changes are responses to increased fishing, then per-recruit models are not appropriate to predict the effects of any past or future regulations. Models providing for differential growth efficiencies, and competition and food-related recruitment relationship are required. (Authors)

9930. Whitworth, Walter R. (College of Agriculture, Univ. of Connecticut, Storrs, Conn.). 1968. EFFECTS OF DIURNAL FLUCTUATIONS OF DISSOLVED OXYGEN ON THE GROWTH OF BROOK TROUT. J. Fish. Res. Bd. Canada, 25(3): 579-584.

9931. Alderdice, D.F., and F.P.J. Velsen (Fisheries Research Board of Canada Biological Station, Nanaimo, B.C., Canada). 1968. DESIGN OF A CONTROLLED-ENVIRONMENT INCUBATOR FOR SMALL MARINE FISH EGGS. J. Fish. Res. Bd. Canada, 25(3): 585-588.

9932. Powles, P.M., D.G. Garnett, G.D. Ruggieri, S.J., and R.F. Nigrelli (Fisheries Research Board of Canada Biological Station, St. Andrews, N.B., Canada). 1968. Ichthyophonus INFECTION IN YELLOWTAIL FLOUNDER (Limanda ferruginea) OFF NOVA SCOTIA. J. Fish. Res. Bd. Canada, 25(3): 597-598.

9933. Sparrow, R.A.H. (Fisheries Research Board of Canada Biological Station, Nanaimo, B.C., Canada). 1968. A FIRST REPORT OF CHUM SALMON FRY FEEDING IN FRESH WATER OF BRITISH COLUMBIA. J. Fish. Res. Bd. Canada, 25(3): 599-602.

9934. Nakano, T., and N. Tomlinson (Fisheries Research Board of Canada, Vancouver Lab., Vancouver, B.C., Canada). 1968. ADDENDUM: CATECHOL-AMINE AND CARBOHYDRATE CONCENTRATIONS IN RAINBOW TROUT (Salmo gairdneri) IN RELATION TO PHYSICAL DISTURBANCE. J. Fish. Res. Bd. Canada, 25(3): 603.

9935. Todd, W.R., L.E. Laastuen, and L.G. Fowler (Univ. of Oregon Medical School, Dept. of Biochemistry, Portland, Oreg.). 1968. INDUCTION OF SKIN PALLOR IN JUVENILE SALMONIDS BY GUANIDINE COMPOUNDS. J. Fish. Res. Bd. Canada, 25(3): 611-612.

9936. Hogan, James W., and Charles O. Knowles (Fish-Pesticide Research Lab., Bur. of Sport Fisheries and Wildlife, Columbia, Mo.). 1968. SOME ENZYMATIC PROPERTIES OF BRAIN ACETYLCHOLINESTERASE FROM BLUEGILL AND CHANNEL CATFISH. J. Fish. Res. Bd. Canada, 25(4): 615-623.

Using a manometric technique an acetylcholinesterase (EC 3.1.1.7, acetylcholine acetylhydrolase) was demonstrated in brain tissue from the bluegill, Lepomis macrochirus Rafinesque, and the channel catfish, Ictalurus punctatus (Walbaum). The activities were 19 and 37 μmoles acetylcholine hydrolyzed/milligram

protein per hour for the bluegill and channel catfish enzymes, respectively. The optimum substrate concentration for the hydrolysis of acetylcholine was 10 mM for the enzymes from both species. Generally, the catfish acetylcholinesterase was somewhat more susceptible than the bluegill to the inhibitors tested; however, the bluegill enzyme was more susceptible to inhibition by malathion and malaoxon. (Authors)

9937. Smith, Stanford H. (Bur. of Commercial Fisheries, Ann Arbor, Mich.). 1968. SPECIES SUCCESSION AND FISHERY EXPLOITATION IN THE GREAT LAKES. J. Fish. Res. Bd. Canada, 25(4): 667-693.

The species composition of fish in the Great Lakes has undergone continual change since the earliest records. Some changes were caused by enrichment of the environment, but others primarily by an intensive and selective fishery for certain species. Major changes related to the fishery were less frequent before the late 1930's than in recent years and involved few species. Lake sutrgeon (Acipenser fulvescens) were overexploited knowingly during the late 1800's because they interfered with fishing for preferred species; sturgeon were greatly reduced in all lakes by the early 1900's. Heavy exploitation accompanied sharp declines of lake herring (Leucichthys artedi) in Lake Erie during the 1920's and lake whitefish (Coregonus clupeaformis) in Lake Huron during the 1930's. A rapid succession of fish species in Lakes Huron, Michigan, and Superior that started about 1940 has been caused by selective predation by the sea lamprey (Petromyzon marinus) on native predatory species, and the resultant shifting emphasis of the fishery and species interaction as various species declined. Lake trout (Salvelinus namaycush) and burbot (Lota lota), the deep-water predators, were depleted first; this favored their prey, the chubs (Leucichthys spp.). The seven species of chubs were influenced differently according to differences in size. Fishing emphasis and predation by sea lampreys were selective for the largest species of chubs as lake trout and burbot declined. A single slow-growing chub, the bloater, was favored and increased, but as the large chubs declined the bloater was exploited by a new trawl fishery. The growth rate and size of the bloater increased, making it more vulnerable to the conventional gillnet fishery and lamprey predation. This situation in Lakes Michigan and Huron favored the small alewife (Alosa pseudoharengus) which had recently become established in the upper Great Lakes, and the alewife increased rapidly and dominated the fish stocks of the lakes. The successive collapses of various stocks after periods of stable production may give some indication of their sustainable yield. The sea lamprey is being brought under control in Lakes Superior, Michigan, and Huron; lake trout are being established; and chinook salmon (Oncorhynchus tshawytscha), coho salmon (O. kisutch), kokanee salmon (O. nerka), and the splake, a hybrid of lake trout and brook trout (Salvelinus fontinalis), are being introduced to reestablish a new species balance. Fish stocks are in a state of extreme instability in these lakes. Careful control of stocking programs and fisheries, and coordination of management among the various states of the United States and the province of Canada (Ontario) which manage the fish stocks, will be required to restore and maintain a useful fishery balance. (Auth.)

9938. Hergenrader, Gary L., and Arthur D. Hasler (Laboratory of Limnology, Univ. of Wisconsin, Madison, Wisc.). 1968. INFLUENCE OF CHANGING SEASONS ON SCHOOLING BEHAVIOR OF YELLOW PERCH. J. Fish. Res. Bd. Canada, 25(4): 711-716.

Analysis of echo-sounder and sonar records made on Lake Mendota during summer and winter indicated that the schooling behavior of yellow perch, Perca flavescens (Mitchill), changed markedly between the two seasons. The distance separating individuals in schools during summer was less than 1.5-2.0 ft, consequently producing dense traces on the recorder charts which showed no definition of individuals. During winter, however, the fish-to-fish distances often were greater than 1.5-2.0 ft, producing many traces showing the individual fishes in a school. The mean distance between the top and bottom fish in a school during winter was 22.1 ft (6.7 m); in summer only 8.5 ft (2.5 m). High correlations existed between light transmission of the water and school size ($r = .77$) and between temperature and school size ($r = -.89$). The possible adaptive significance of this seasonal change in behavior is discussed. (Authors)

9939. Parker, Robert R. (Fisheries Research Board of Canada Biological Station, Nanaimo, B. C., Canada). 1968. MARINE MORTALITY SCHEDULES OF PINK SALMON OF THE BELLA COOLA RIVER, CENTRAL BRITISH COLUMBIA. J. Fish. Res. Bd. Canada, 25(4): 757-794.

The hypothesis that natural mortality rates of pink salmon during early life are generally much larger than during the later period has been tested for 3 brood-years of the Bella Coola River stock using a two-stage marking technique. Average daily losses to the population during the first 40 days are estimated to vary between 2 and 4%, and for the later 410-day period between 0.4 and 0.8%. The rates produce losses amounting to between 59 and 77% of the initial population during the first 40 days. Of the population surviving at 40 days, further losses of between 78 and 95% occurred. The latter losses are considered to be maximum estimates because of bias introduced by catches of unknown magnitude. Thus, although the early mortality is exceeded by the later, the time period is approximately 10 times as long, and the intensity of the mortality rate is much higher during early sea life. (Auth.)

9940. Waldron, Kenneth D. (Bur. of Commercial Fisheries Biological Lab., Seattle, Wash.). 1968. EARLY LARVAE OF THE CANARY ROCKFISH, Sebastodes pinniger. J. Fish. Res. Bd. Canada, 25(4): 801-803.

This note presents the first description of early larvae of the canary rockfish, Sebastodes pinniger (Jordan and Gilbert), 1880.

9941. Gruchy, C.G., and V.D. Vladykov (Dept. of Biology, Univ. of Ottawa, Ottawa, Ont., Canada). 1968. SEXUAL DIMORPHISM IN ANAL FIN OF BROWN TROUT, Salmo trutta, AND CLOSE RELATIVES. J. Fish. Res. Bd. Canada, 25(4): 813-815.

In brown trout and two close relatives through most of the life history, the anal fin was of two distinct shapes: falcate or notched in females and rounded or convex in males. Anal fin dimorphism was found only in forms of brown trout, in Sevan trout, Salmo ischchan, and in Ohrid trout, S. letnica.

9942. Caulfield, W. (Fisheries Research Board of Canada Biological Station, Nanaimo, B. C., Canada). 1968. METHOD FOR COUNTING COHO FRY IN SMALL STREAMS. J. Fish. Res. Bd. Canada, 25(4): 823.

In the spring and summer, the coho fry and under-yearlings mill about the pools in large numbers. Canned salmon thrown onto the surface will bring a quick initial response of the fry. The food brings the fry together and holds them because of their competitiveness. A quick count of the fry is made as they feed.

9943. Grinols, Richard B., and Charles D. Gill (Bur. of Commercial Fisheries Exploratory Fishing and Gear Research Base, Seattle, Wash.). 1968. FEEDING BEHAVIOR OF THREE OCEANIC FISHES (Oncorhynchus kisutch, Trachurus symmetricus, AND Anoplopoma fimbria) FROM THE NORTHEASTERN PACIFIC. J. Fish. Res. Bd. Canada, 25(4): 825-827.

Feeding behavior and stomach content analysis correspond to earlier evidence suggesting that salmon are opportunistic feeders. Jack mackerel were in schools of up to 40 individuals about 3-5 m beneath the surface, well below concentrations of saury and lanternfish. Jack mackerel appeared to select and pursue individual prey. After a few moments, the mackerel would school again for a short time before repeating the feeding pattern. Sablefish would approach the lighted area either singly or in groups of up to 12 individuals. In all instances, an individual sable would seek out its selected prey at the surface, then leave and wait for the prey to re-concentrate beneath the lights. Their predatory activity appeared to be more premeditated toward single individuals than either of the other species.

9944. Childers, William F. 1967. HYBRIDIZATION OF FOUR SPECIES OF SUNFISHES (CENTRARCHIDAE). Illinois Natural History Survey Bulletin, Vol. 29, Article 3. 214 p.

Redear sunfish, bluegill, green sunfish and warmouth.

9945. Malyukina, G.A. 1966. FUNCTIONAL CHARACTERISTICS AND THE ROLE OF CHEMICAL SENSE ORGANS IN THE AGGREGATIVE BEHAVIOR OF FISHES. In: Report summaries of the All-Union Conference on the Ecology and Physiology of Fishes, 1966. Moscow. 133-134. From: Ref. Zh., Biol., 1967, No. 2I150. (Translation); Biological Abstracts, 48(19): Abst. No. 94377. 1967.

Minnows, crucian carp and carp locate schools only by chemoreceptors; in mullets this phenomenon was not observed. Chemoreception is best developed in minnows. The visual organs had no effect on this process. Minnows, crucian carp and carp reacted to the "smell" of other fish species. The "smell" of predators evoked a strong reaction in the fish.

9946. Manteifel', B.P., I.I. Girsa, T.S. Leshcheva, and D.S. Pavlov. 1965. DIEL RHYTHMS OF FEEDING AND OF THE MOTOR ACTIVITY OF FRESHWATER PREDACIOUS FISHES. In: The feeding of predacious fishes and their relationships with food organisms. Nauka: Moscow. 3-81. From: Ref. Zh., Biol., 1966, No. 6I100. (Translation); Biological Abstracts, 48(19): Abst. No. 94379. 1967.

The diel feeding rhythm of predacious fishes of Rybinsk Reservoir (perch, zander, pike) was examined, as well as their food (young perch). Variation in the rhythm of activity in relation to variation of illumination was investigated in pike, zander, perch, verkhovka (Leucaspius delineatus), ruffe and bream. To determine the time at which the fish were seized by predators, special observations were made on the rate of digestion of these fish. In the results are presented the smaller fractional units of digestion, based on Fortunatova's scale of digestion of food by predatory fishes. The influence of temperature and amount of food on the digestive rate is demonstrated. The dynamics of underwater illumination in the course of a 24-hour period, and at various depths of the Rybinsk Reservoir in July, is examined. The feeding intensity of predatory fishes, estimated on the basis of the rate of capture of the prey, varies in the course of 24 hours, but the main feeding time of pikes and perches is during the morning and evening hours. Zander capture most of their prey during the first half of the night. Characteristics of the daily feeding rhythm are discussed in connection with the development of sense organs of predatory fishes and of their prey, as well as in connection with the behavior patterns of predators and prey at various hours of the day, at various conditions of illumination, which alters the availability of food for predatory fishes. Illumination at which the activity of fishes was maximal coincided with the light conditions during which food consumption was maximal.

9947. Muntyan, S.P. 1966. EFFECT OF CONSTANT INCUBATION TEMPERATURES ON THE HATCHING PROCESS AND ON THE MORPHOLOGICAL CHARACTERS OF PIKE-PERCH EMBRYOS. In: Report summaries of the All-Union Conference on the Ecology and Physiology of Fishes, 1966. Moscow. 88. From: Ref. Zh., Biol., 1967, No. 2I121. (Translation); Biological Abstracts, 48(19): Abst. No. 94387. 1967.

Pike-perch ova were incubated at 2 different temperatures in thr range of 5 to 26.5° C. Most of the embryos hatched during the 7th stage. The largest numbers of normal embryos hatched at 11.5-14° C. Embryos incubated at 11.5° C had the greatest body length.

9948. Nabiev, A.I. 1966. THE USE OF PETROLEUM GROWTH SUBSTANCES IN FISH CULTURE. In: Report summaries of the All-Union Conference on the Ecology and Physiology of Fishes, 1966. Moscow. 31-32. From: Ref. Zh., Biol., 1967, No. 2I191. (Translation); Biological Abstracts, 48(19): Abst. No. 94388. 1967.

Egg fertilization and rearing of larvae and of their food organisms were carried out in solutions containing a petroleum growth substance in doses of 0.01, 0.05, and 0.1 and 0.5 mg/l. The experiments were conducted on roach, bream, white-eyed bream, spiny sturgeon, Russian sturgeon and sevriuga. In all cases the incubation period was shortened and the growth rate of the young increased. Best results were obtained when the growth substances were given in a dose of 0.5 mg/l.

9949. Piskarev, K. V., E. Omorov, and I. Ibragimov. 1965. EXPERIMENTS IN THE REARING OF CARP IN RICE FIELDS OF SOUTHERN KIRGHIZIA. Uch. Zap. Oshskogo. Gos. Pedagog. Inst. (6): 3-13. From: Ref. Zh., Biol., 1966, No. 6I170. (Translation); Biological Abstracts, 48(19): Abst. No. 94396. 1967.

The fish were reared in rice fields in an area of 1.1-1.2 ha. Planting material were carp yearlings averaging 40 g in weight and 15 cm in length (200-300 individuals/ha); mixed plantings of yearlings and fingerling (500-600 individuals/ha of yearlings and 700 individuals/ha of fingerlings). During the first days, young carp in the rice fields feed on zoo- and phyto-plankton, and later on midge larvae and pupae, oligochaete worms and occasionally on plant seeds. The food composition of carp yearlings shows that their greatest weight increments result from eating plants. After 107 days of rearing, the carps attained an average weight of 574 g and an average length of 31 cm. Fish production was 105 kg/ha; with mixed stockings of yearlings and fingerlings it may reach 250 kg/ha. Carp culture has a favorable effect on rice production (extermination of pests, fertilization of soil), increasing the rice crop by 10-15 percent.

9950. Popova, O. A. 1965. THE ECOLOGY OF PIKE AND PERCH IN THE VOLGA DELTA. In: The food of predacious fishes and their relationships with their food organisms. Nauka: Moscow. 91-172. From: Ref. Zh., Biol., 1966, No. 6I122. (Translation); Biological Abstracts, 48(19): Abst. No. 94400. 1967.

The ecology of pike and perch prior to the damming of the Volga in 1952-53, and during the first years of the damming, 1956-58, was investigated. Studies have been made of the changes in abundance and catches of pike and perch in the delta; of their distribution during the past 60 years; of the changes in the size, age and sex composition; of the spawning patterns of the fish and survival rates of spawn and fry; and of the fecundity and state of nourishment. An analysis is given of the size-age structure of the predator population, and of the feeding relationships between pike and perch in the Volga delta over the course of several years. An examination of about 1,500 pike, and over 2,500 perch, showed that each of these predaceous species was represented by a single population and that these populations utilized different habitats at different periods of their lives, thereby achieving a greater degree of utilization of the food resources of the entire delta. Despite the fact that the pike and perch occupied the same habitat, no competition over food, over breeding grounds, and the like, has developed between them, which is explained by the morphological specificity of each species, which occupied different ecological niches. There were marked differences in growth rate, in survival rates of pike and perch at various stages of development, in their maturation and spawning patterns, and in their feeding habits (foraging grounds, composition and size of food components, feeding rhythm). A sharp fall in the level of the Caspian Sea during the past 30 years, coupled with the regulation of the Volga flow, which began in 1966, have led to substantial changes in the delta's ecological conditions. The living conditions of young pike and perch became impoverished, as did the conditions for their spawning and fattening, resulting in a poorer growth rate. In perch there appeared groups that differed in growth rates, in times of maturation and sex ratios, in feeding characteristics, and so on. On the other hand, heavy shoaling of the pro-estuarine region and utilization by predators of this new habitat have led to a significant improvement in the biological indices of adult predators in the pro-estuary, in comparison with the lower zone, and to a sharp increase in the numbers of predators throughout the entire delta.

9951. Ryzhkov, L. P. 1966. THE EFFECT OF ENVIRONMENTAL CONDITIONS ON SOME METABOLIC ASPECTS OF THE SEVAN TROUT. In: Report summaries of the All-Union Conference on the Ecology and Physiology of Fishes, 1966. Moscow. 60-62. From: Ref. Zh., Biol., 1967, No. 2I104. (Translation); Biological Abstracts, 48(19): Abst. No. 94407. 1967.

A study was made of the daily food ration and of the effect of various light conditions on the development of winter, summer and fast-growing forms of the Sevan trout. The rate of morphogenesis rises with light.

9952. Sharonov, I.V. 1966. FORMATION OF RESERVOIR FISH FAUNA. In: Ecology of aquatic organisms. Nauka: Moscow. 103-110. From: Ref. Zh., Biol., 1967, No. 21166. (Translation); Biological Abstracts, 48(19): Abst. No. 94414. 1967.

The formation of a natural reservoir fish fauna is based on parental river and lake populations of the flood zone. The stock formation process is accompanied by a strengthening of the limnophilic, and a suppression or complete disappearance of rheophilic complexes. The process can be divided into 3 stages: 1) rapid rise in abundance, increase in growth rate and state of nourishment, 2) sharp drop in growth of rheophilic fish stocks, reduction in growth rate and condition of benthophagic fishes, 3) alternation of weak and strong year-classes, stabilization of growth, increase in abundance of low-value and coarse fish. The first stage is connected with the filling period. The sharp rise in abundance and growth rate is a consequence of better reproductive and feeding conditions, as well as of the high survival rate of young fish. Decline in benthos biomass and disappearance of spawning substrate (submerged meadow vegetation) in subsequent years exert an adverse effect on the abundance of phytophilic and phytophagous fishes. In the third stage the feeding conditions become relatively stable. The abundance of a stock is mainly determined by water level conditions. The duration of the stock formation period depends to a considerable extent on the time of appearance of the first strong year classes. The formation of a particular stock may be regarded as completed when its spawning part consists of fish of local rather than river origin and when the population achieves the structure normal for the species. An increase in fish production in reservoirs after long-time regulation of the flow, where replenishment of the fish stock proceeds at a relatively rapid rate in years of abundant water, should be based on a rational exploitation of the water-mass, acclimatization of new species and food organisms and modification of flow conditions, with due regard to the interests of the fishery.

9953. Surkova, E.I. 1966. THE LONG LIFE OF PINK SALMON IN FRESH WATER. In: Contributions to the Session of the Academic Council of the Polar Scientific Research Institute of Marine Fisheries and Oceanography on the observations of 1964. Murmansk. 6. 202-205. From: Ref. Zh., Biol., 1967, No. 2168. (Translation); Biological Abstracts, 48(19): Abst. No. 94416. 1967.

In 1963 a total of 1,500 pink salmon fry, 7-11 cm in length and 6-10 g in weight, were planted in a lake. A year later 2 male pinks in stage IV of maturity, with easily detachable scales and river coloration, were recaptured. The fish were 20.5 and 23.1 cm long and weighed 90 and 200 g, respectively. Sclerites on the scales numbered 22 to 25; up to the annual ring, 18. The gill rakers numbered 26, pyloric caeca 94 and 87, and vertebrae 68. The pink salmon continued feeding. Gammarids were found in their stomachs.

9954. Tomnatik, E.N., V.I. Karlov, M.Z. Vladimirov, and A.K. Batyr. 1966. EXPERIMENTAL PIKE-PERCH CULTURE IN MOLDAVIAN HATCHERIES. In: Biological resources of Moldavian waters. Kartya Moldovyaneske: Kishinev. 82-89. From: Ref. Zh., Biol., 1967, No. 21184. (Translation); Biological Abstracts, 48(19): Abst. No. 94419. 1967.

Experiments on the artificial culture of fingerling and yearling pike-perch (in 3 ponds and 2 reservoirs) were carried out in 1963-64. The plantings were made with 2-3-10-day larvae and year-olds. It was established that even fingerling pike-perch exert a significant influence in restricting the abundance of coarse fish. It is believed that in small reservoirs the pike-perch should be reared up to age 1+, without being allowed to spawn. In drainable ponds it may be reared up to 5-6 months of age; in nondrainable ponds, until the abundance of coarse fish has been drastically reduced. In one of the ponds as many as 450-500 coarse fish were taken per haul before the pike-perch was introduced; toward the end of its growing period the number of coarse fish was reduced by a factor of 10. The decrease in the abundance of coarse fish, as a result of pike-perch predation, frees a substantial amount of natural carp food, thereby enhancing the productivity of the fish.

9955. Stevens, E. Don, and D.J. Randall (Dept. Zool., Univ. British Columbia, Vancouver, B.C., Canada). 1967. CHANGES IN BLOOD PRESSURE, HEART RATE AND BREATHING RATE DURING MODERATE SWIMMING ACTIVITY IN RAINBOW TROUT. J. Exp. Biol., 46(2): 307-315; Biological Abstracts, 48(19): Abst. No. 94550. 1967.

The cardiovascular changes occurring during swimming in free-swimming, unanesthetized rainbow trout were recorded via indwelling cannulae in the ventral aorta, dorsal aorta, and sub-intestinal vein. Blood pressure afferent and efferent to the gills increased during moderate swimming activity, and returned to normal levels within 30 minutes after exercise. Venous pressure was characterized by intermittent increases which were not in phase with body movements. Blood flow in the sub-intestinal vein decreased during and after exercise. Heart rate increased by about 15 percent and breathing rate increased by about 30 percent during moderate swimming activity. Both rapidly returned to pre-exercise levels after swimming ceased. Mechanisms regulating heart rate and respiratory rate during activity are discussed. (Authors)

9956. Privol'nev, T.I. 1966. WATER METABOLISM DURING OSMOREGULATION IN FISH. In: Report summaries of the All-Union Conference on the Ecology and Physiology of Fishes, 1966. Moscow. 51-53. From: Ref. Zh., Biol., 1967, No. 2I99. (Translation); Biological Abstracts, 48(19): Abst. No. 94596. 1967.

In high-salinity water, young of freshwater and migratory fishes lose weight through loss of tissue water. The water content in the blood plasma does not diminish; some of the water that penetrates into the blood maintains the organism's internal environment constant despite the elevated salt content in the plasma.

9957. Robertson, O.H., Marcus A. Krupp, Noel Thompson, Sydney F. Thomas, and Satoshi Hane (Palo Alto Med. Res. Found., Stanford Univ., Palo Alto, Calif.). 1966. BLOOD PRESSURE AND HEART WEIGHT IN IMMATURE AND SPAWNING PACIFIC SALMON. Amer. J. Physiol., 210(5): 957-964; Biological Abstracts, 48(19): Abst. No. 94919. 1967.

To ascertain whether or not hypertension, characteristic of Cushing's syndrome, was present in Pacific salmon exhibiting an analogous type of hyperadrenocorticism, study was made on blood pressure in salmon at several stages of their spawning migration and sexual maturation. Measurements of blood pressure were determined in the heart, the ventral aorta, and the dorsal aorta by means of a strain gauge connected with needles inserted into these 3 sites. Ecg readings were taken at the same time. It was found that there was no significant change in either systolic or diastolic blood pressure from the time the salmon entered the river in a state of sexual immaturity until they spawned 1-6 months later. In many of the spawning fish high levels of 17-hydroxycorticosteroids had been present for probably 4-5 months. Heart weights were less in spawning than in immature fish. Heart rate, the character of the ecg, pulse pressure in the systemic circulation, and comparison with blood pressure in steelhead trout are discussed. (Authors)

9958. Chernikova, V.V. 1966. SEASONAL BLOOD CHARACTERISTICS OF FRESH WATER FISHES. In: Report summaries of the All-Union Conference on the Ecology and Physiology of Fishes, 1966. Moscow. 88-90. From: Ref. Zh., Biol., 1967, No. 2I122. (Translation); Biological Abstracts, 48(19): Abst. No. 95053. 1967.

The blood characteristics of bream, perch, pike, peled and Volkhov whitefish were characterized by significant seasonal changes. In burbot and ruffe these changes were less marked; in roach they were not observed. Volkhov whitefish spawners that were kept over a 24-hour period in an enclosed space in a cement basin exhibited a decrease in Hb concentration along with other changes.

9959. Turner, Jerry L., and D.W. Kelley. 1966. ECOLOGICAL STUDIES OF THE SACRAMENTO-SAN JOAQUIN DELTA. PART II. FISHES OF THE DELTA. California Dept. of Fish and Game Fish Bulletin 136. 168 p.

9960. Egorova, M. N. 1966. BLOOD VOLUME AND HEMOGLOBIN CONCENTRATION OF SOME MARINE FISHES. In: Report summaries of the All-Union Conference on the Ecology and Physiology of Fishes, 1966. Moscow. 90-92. From: Ref. Zh., Biol., 1967, No. 21123. (Translation); Biological Abstracts, 48(19): Abst. No. 95058. 1967.

Blood volume in horsemackerel, striped mullet and scorpionfish was 1.83, 17.8 and 1.41 percent of body weight, respectively. Blood volume in spawning fish was higher. Hb concentration was for the horsemackerel 2.3, for the striped mullet 1.8 and for the scorpionfish 0.76 g/kg. In young fishes the Hb concentration was higher.

9961. Binna, Niles Allen. 1967. EFFECTS OF ROTENONE TREATMENT ON THE FAUNA OF THE GREEN RIVER, WYOMING. Wyoming Game and Fish Comm. Fisheries Research Bulletin No. 1. 114 p.

From July 1962 to October 1964, samples were taken of the invertebrates and fishes of the Green River in southwestern Wyoming to determine the effects of rotenone treatment on the river fauna. The river was treated in September 1962, with emulsified rotenone, and concentrations applied to the river ranged from 2.5 ppm to nearly 10 ppm of a 5% rotenone product. The reaction of the fauna to the toxicant was investigated at the time of treatment, and post-treatment population levels of the fauna were followed closely to establish the time needed for recovery to pretreatment levels. Fish as well as adult beetles, leeches, snails, stonefly nymphs, and other invertebrates were observed dying during the treatment; their bodies were often conspicuous in quiet eddies of the river. Many of the fishes fled downstream ahead of the rotenone during the treatment, but were eventually trapped at the next rotenone introduction station. Reactions of intoxicated fish are described. The invertebrate populations in the Green River were drastically reduced by the rotenone treatment, but began to reappear in the upper 30 miles of the treated area within one month. The lower treated area was almost barren of invertebrate organisms until the spring of 1963. By September 1963, invertebrate numbers throughout the treated area were equal to or greater than those found prior to treatment, but changes in the composition of the invertebrate fauna were noticeable. Sufficient fish food organisms to sustain a fishable trout population were present by the late summer of 1963. A succession of invertebrate groups occurred during the post-treatment recovery period. Two years after treatment, the patterns of dominant invertebrate groups in the river were still dissimilar to pretreatment patterns. Tendipedidae were usually the predominant organism. Two rare mayfly genera, Pentagenia and Hexagenia, did not reappear after treatment, but several other mayfly genera, including Leptophlebia, Traverella, Iron, Paraleptophlebia, and Isonychia, apparently immigrated into the area. Intensive sampling with dynamite and gill nets immediately after the treatment produced no fish in the mainstream below the upper ten miles of the treated area. A few untreated sloughs were probably the source from which the river was later repopulated by flannelmouth suckers, Pantosteus suckers, redside shiners, speckled dace, fathead minnows, and carp. These species, except for carp, had regained their pretreatment distribution at the close of study. Carp were found only in scattered areas. Whitefish and brown trout required nearly two years to regain their pretreatment distribution pattern. This apparently was due to a slow downstream migration from untreated areas. Forage fish were abundant two years after treatment, but coarse fish population numbers were still below pretreatment levels. Squawfish, humpback suckers, channel catfish and black bullheads did not reappear after treatment apparently because the only source of recruitment was below Flaming Gorge Dam. Small bonytail chubs reappeared in parts of the treated area in the second summer, probably from parts of the drainage above the treated area. Large numbers of rainbow trout were planted in the treated area six months after treatment and are now supporting a successful trout fishery. Rotenone concentrations were determined during the treatment using bioassay techniques and a colorimetric method. Bioassays appeared to give the most accurate results. (Auth.)

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1955

20,813,000
Sport Fishermen

1960

25,323,000
Sport Fishermen

1965

28,348,000
Sport Fishermen

(From National Survey of Fishing and Hunting)

☆ U. S. GOVERNMENT PRINTING OFFICE : 1968 O - 313-741

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As the Nation's principal conservation agency, the Department works to assure that nonrenewable resources are developed and used wisely, that park and recreational resources are conserved, and that renewable resources make their full contribution to the progress, prosperity, and security of the United States—now and in the future.